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AERODYNAMIC LOADS ON FOUR EXTERNAL STORES IN THE CARRIAGE POSITION ON THE A-7D AND F-4C AIRCRAFT AT MACH NUMBERS FROM 0.5 TO 2.0

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ARO, Inc.

PROPULSION WIND TUNNEL FACILITY
ARNOLD ENGINEERING DEVELOPMENT CENTER
AIR FORCE SYSTEMS COMMAND
ARNOLD AIR FORCE STATION, TENNESSEE 37389

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Final Report for Period October 19 — November 16, 1973

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This technical report has been reviewed and is approved.
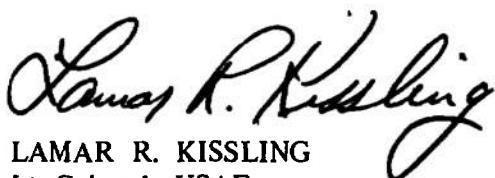
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A-7D aircraft	subsonic flow
external stores	supersonic flow

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Aerodynamic force and moment measurements were made on 0.05-scale models of the M-117GP and BLU-1C/B bombs, the 300-gal fuel tank, and the AGM-62/A Walleye missile in the carriage position on the A-7D and F-4C aircraft at Mach numbers from 0.5 to 2.0. The aircraft model angle of attack was varied from -4 to 12 deg and the yaw angle from -8 to 8 deg. Studies were made to evaluate

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19, Continued

bomb racks

multiple ejector rack

M-117 bomb

BLU-1C/B bomb

AGM-62/A Walleye missile

20, Continued

the effects of store nose shape variation and store location on
the multiple ejection rack and pylon on the measured aerodynamic
coefficients. This report contains a description of the test
along with information to identify test configurations and test
conditions for all data obtained. Only a limited amount of data
is presented to show the magnitude of the store aerodynamic
loads and variations caused by changes in the aircraft configu-
ration.

AFSC
Arnold AFS Tenn

PREFACE

The work reported herein was done by the Arnold Engineering Development Center (AEDC) for the Air Force Armament Laboratory (AFATL/DLJA), Air Force Systems Command (AFSC), under Program Element 64602F, Project 5613. AFATL Project monitor was Mr. R. Hume, AFATL/DLJA. The test results presented were obtained by ARO, Inc. (a subsidiary of Sverdrup & Parcel and Associates, Inc.), contract operator of AEDC, AFSC, Arnold Air Force Station, Tennessee, under ARO Project No. PA288. The manuscript (ARO Control No. ARO-PWT-TR-74-16) was submitted for publication on February 6, 1974.

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1.0 INTRODUCTION

Wind tunnel tests were conducted using 0.05-scale models of the A-7D and F-4C aircraft with 300-gal fuel tank, M-117GP and BLU-1C/B bombs, and AGM-62/A Walleye external stores to obtain aerodynamic force and moment data on the stores in the carriage position. Interference effects caused by adjacent stores and store nose geometrical variations were investigated for various positions of the stores on the pylons and multiple ejector racks (MER). Data were obtained at Mach numbers from 0.5 to 2.0, aircraft angles of attack from -4 to 12 deg, and yaw angles from -8 to 8 deg. In addition to the external store data obtained on both models, aerodynamic force and moment data were obtained on the A-7D aircraft model.

A description of the test, along with information to identify test configurations and test conditions for all data acquired, is included herein. Only selected data are presented to show the magnitudes and some typical variations of the force and moment coefficients for stores in the flow field of the A-7D aircraft.

2.0 APPARATUS

2.1 TEST FACILITY

The Aerodynamic Wind Tunnel (4T) is a closed-loop, continuous flow, variable density tunnel in which the Mach number can be varied from 0.1 to 1.3. Also, nozzle blanks can be installed to give nominal Mach numbers of 1.6 and 2.0. At all Mach numbers, the stagnation pressure can be varied from 300 to 3700 psfa. The test section is 4 ft square and 12.5 ft long with perforated, variable porosity (0.5- to 10-percent open) walls. It is completely enclosed in a plenum chamber from which the air can be evacuated, allowing part of the tunnel airflow to be removed through the perforated walls of the test section. A more complete description of the test facility can be found in the Test Facilities Handbook.[1]

The tunnel support system for the models consists of a pitch sector strut and sting attachment which has a pitch capability of -12 to 28 deg with respect to the tunnel centerline and a roll capability of -180 to 180 deg with respect to the sting centerline. A schematic of the test section showing the location of the models is presented in Fig. 1.

---

[1]Test Facilities Handbook (Ninth Edition). "Propulsion Wind Tunnel Facility, Vol. 4." Arnold Engineering Development Center, July 1971.

2.2 TEST ARTICLES

The test articles were 0.05-scale models of the A-7D aircraft, F-4C aircraft, 300-gal fuel tank, M-117GP bomb, BLU-1C/B finned firebomb, and AGM-62A Walleye guided bomb. Dimensional sketches of the A-7D and F-4C models are shown in Figs. 2 and 3. The horizontal tail settings of the A-7D and F-4C were both at -5 deg incidence, with respect to the model waterline, during testing. The wing root chord of the A-7D and F-4C have -1.0 and 1.0 deg incidence, respectively, with respect to the waterline. All tests were conducted with forced boundary-layer transition on the aircraft models.

Details and dimensions of the A-7D and F-4C pylons are shown in Figs. 4 and 5, respectively. The inboard and outboard F-4C pylons had provisions for shifting the store ±12 in. full scale relative to the standard carriage position.

Two MER-model geometries were used during testing. The instrumented MER/10/N, shown in Fig. 6, was used at pylon stations where store aerodynamic data were taken, and the noninstrumented MER, shown in Fig. 7, was used at stations where only dummy models were required.

Details and dimensions of the external stores used during the test are shown in Figs. 8 through 13. Also shown in Figs. 8 and 9 are the nose bluntness adaptors used on the M-117GP and the 300-gal fuel tank, respectively. Figures 14 and 15 show installation schematics of the instrumented M-117 on the MER and the 300-gal fuel tank on the pylon, respectively. Figure 16 is a photograph showing the F-4C aircraft installation. The orientation and numbering of the MER store stations are shown in Fig. 17.

2.3 INSTRUMENTATION

Six 5-component and one 6-component internal strain-gage balances of different load capacities were used to obtain force and moment data on the external stores. A 6-component strain-gage balance was used to obtain similar data on the A-7D model. Base pressure measurements were obtained with a pressure transducer connected to one orifice located in the balance cavity of the A-7D model.

The A-7D and store models with balances were instrumented with individual fouling circuits to detect any contact with adjacent stores, racks, or support stings. The F-4C aircraft model angle of attack was set using an absolute angle-of-attack indicator located in the nose of the fuselage.

3.0 TEST DESCRIPTION

3.1 TEST CONDITIONS AND PROCEDURES

Force and moment data were obtained on the various store configurations at discreet Mach numbers of 0.5, 0.7, 0.9, 1.05, 1.2, 1.6, and 2.0. Tunnel stagnation pressures ranged from 3000 psfa at $M_\infty = 0.5$ to 1400 psfa at $M_\infty = 2.0$, and the total temperature varied from 90° to 120°F. The test section wall porosity was varied with free-stream Mach number in order to achieve the minimum lift interference while reducing blockage effects. The tunnel conditions were held constant at the prescribed Mach number while the angle of attack was varied from -4 to 12 deg in 2-deg increments.

3.2 CORRECTIONS

Balance and sting deflections caused by aerodynamic loads on the store and aircraft models were accounted for in the data reduction program to determine the true angle of attack. Store model weight tare corrections were made to calculate net aerodynamic forces on the models. Weight tare corrections for the A-7D model were determined only for Configurations 1, 3, and 29. The remaining A-7D configurations were tested with Configuration 1 tare corrections. A base pressure drag correction was made for the A-7D model to obtain forebody aerodynamic coefficients.

To determine wind tunnel flow angularity, the A-7D model was run in both upright and inverted positions. A flow angle deviation that varied with Mach number was determined. All data were corrected for this flow angularity, which varied from 0.27 deg upwash at Mach number 0.5 to 0.15 deg upwash at Mach number 2.0.

3.3 PRECISION OF MEASUREMENTS

The precision of the data which can be attributed to the inaccuracies in balance measurements and in setting tunnel conditions was determined for a confidence level of 95 percent and is presented below for the set of conditions that produced the largest errors. The uncertainty in Mach number is within ±0.005, and the uncertainty in angle of attack is within ±0.1 deg.

	ΔC_N	ΔC_m	ΔC_Y	ΔC_n	ΔC_A	ΔC_ℓ
A-7D	±0.0068	±0.0033	±0.0046	±0.0011	±0.0021	±0.00045
300-gal fuel tank or AGM-62/A	±0.048	±0.097	±0.018	±0.036	±0.024	±0.015
M-117GP or BLU-1C/B	±0.012	±0.020	±0.011	±0.016	—	±0.09

7

4.0 TEST RESULTS

The large volume of data obtained during the test precludes a complete analysis of all test results at this time. Since obtaining the store loads data was the primary objective of the test (obtaining A-7D aircraft loads was a secondary objective), some data are presented to show the magnitude and variations of the store aerodynamic coefficients for various configurations. Information pertaining to all test data obtained is discussed in Section 4.1. Selected store loads data are presented in Figs. 18 and 19 and are discussed in Section 4.2.

4.1 SUMMARY OF TEST DATA INFORMATION

Information pertaining to data obtained during the test is presented in Tables 1 through 3. Aircraft and store reference dimensions used in the coefficient data reduction are shown in Table 1. A listing of all acquired data as a function of test configuration and test conditions with test run identification number (part number) is presented in Table 2 for the A-7D aircraft and in Table 3 for the F-4C aircraft.

Force and moment coefficient data were measured on the M-117GP, BLU-1C/B, 300-gal fuel tank, and AGM-62/A Walleye on the A-7D and F-4C aircraft at the fuselage centerline and wing pylon stations. Aerodynamic load measurements were made on the BLU-1C/B and M-117GP stores on various MER stations and on the 300-gal fuel tank and AGM-62/A Walleye on the wing pylons. Load measurements were made on the M-117GP and 300-gal fuel tank with the standard, ogive, and hemispherical nose shapes. In addition, data were taken with the 300-gal fuel tank and the AGM-62/A Walleye shifted 12 in. full scale both forward and aft with respect to the standard carriage position on the F-4C inboard and outboard wing pylons.

4.2 STORE LOADS DATA

Figures 18 and 19 show the effect of A-7D and F-4C aircraft angle of attack and MER/pylon position on the aerodynamic coefficients of the M-117GP store for each MER carriage position at Mach number 0.9.

Aerodynamic coefficients for the M-117GP store on the A-7D aircraft showed the largest loads and greatest variation with angle of attack for the stores mounted on the forward shoulder stations of the MER (stations 4 and 6). In general, loads were slightly greater when the MER was on the outboard or center wing pylon than when it was on the inboard wing or fuselage center pylon.

For the M-117GP on the F-4C aircraft, the largest loads were encountered by the stores on the forward center and outboard shoulder stations of the MER (stations 2 and 6) with the MER on the wing pylons. The variation of loads with angle of attack was generally less for stores on the fuselage centerline than for those on the wing pylons.

60° — 0.500 DIAM   — AIRSTREAM SURFACE

0.375   0.375

0.375

TYPICAL PERFORATED WALL CROSS SECTION

ALL DIMENSIONS AND TUNNEL
STATIONS IN INCHES

— SOLID AREAS   — PERFORATED WALLS (10% MAXIMUM OPEN AREA)

FLOW
EXPANSION
REGION

STA.
0.0

STA.
36.0

STA.
88.9
F-4C

STA.
90.5
A-7D

STA.
150.0
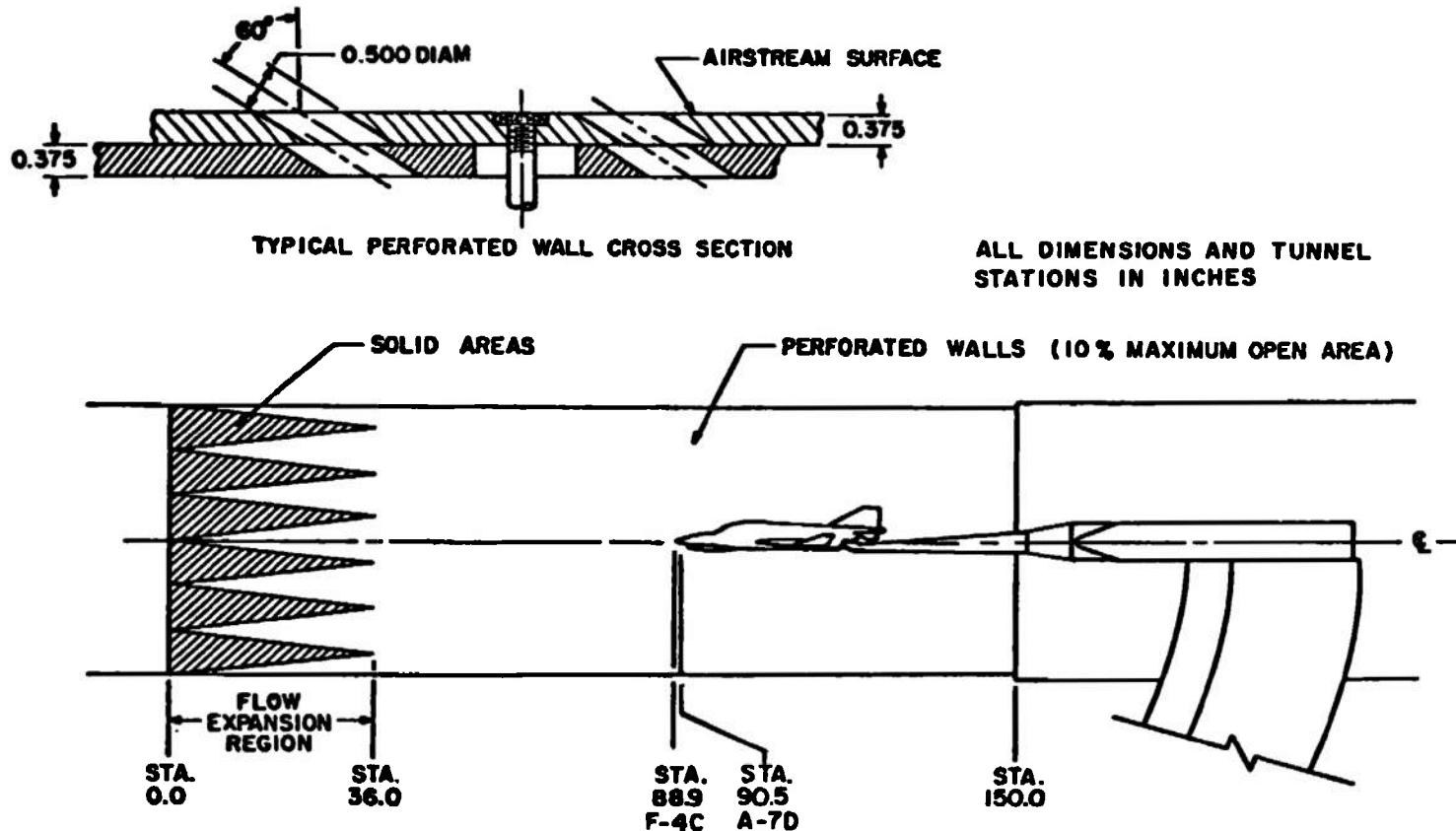
Figure 1. Schematic of tunnel test section showing model location.

BL 0.000

B L-3.060

B L-4.860

B L-6.831

BL-11.619

ALL DIMENSIONS IN INCHES

M S 0.000

13.304 13.758 15.468 15.666
(BL = 0.000)

28.805
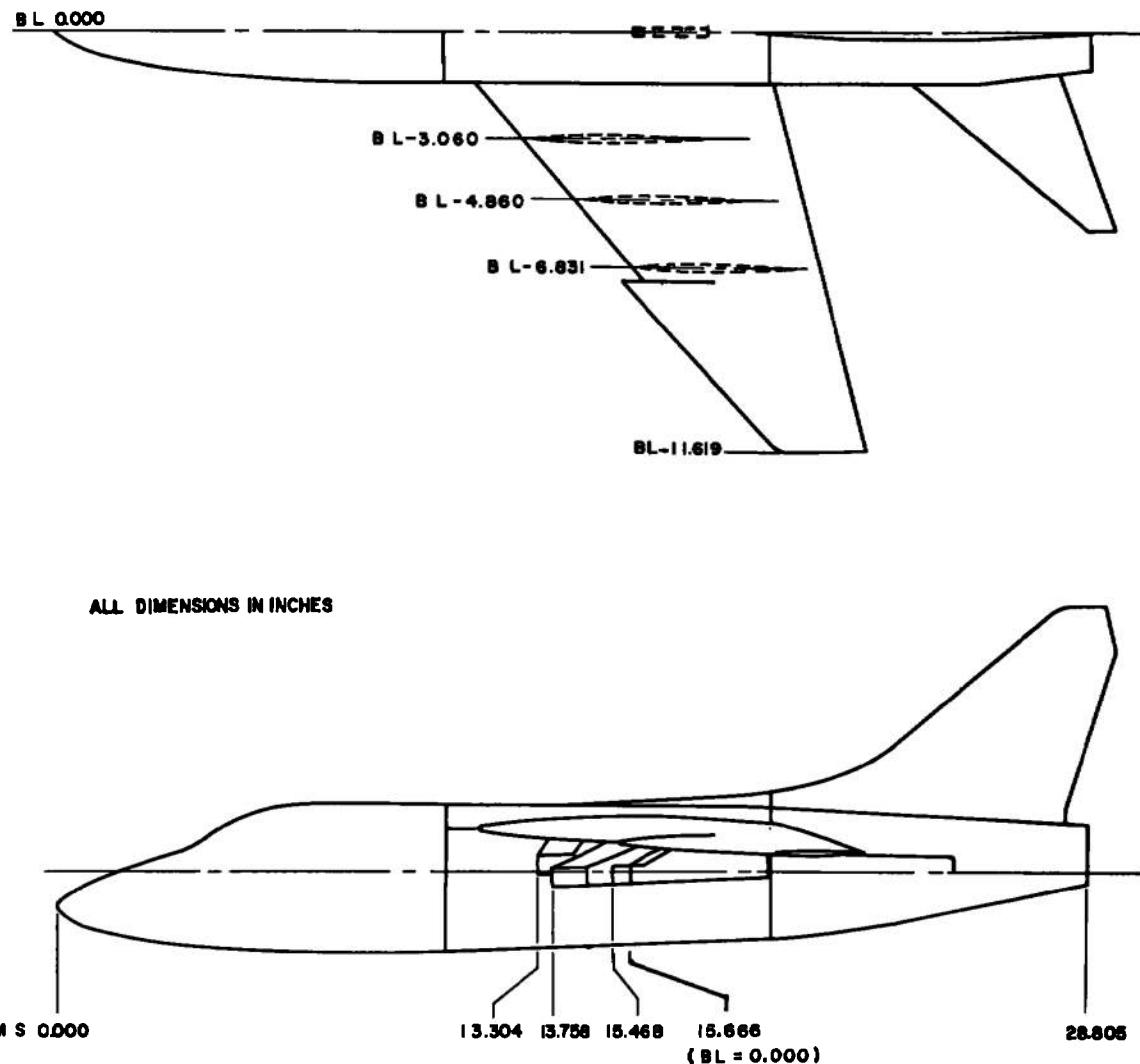
Figure 2. Sketch of the A-7D aircraft model.
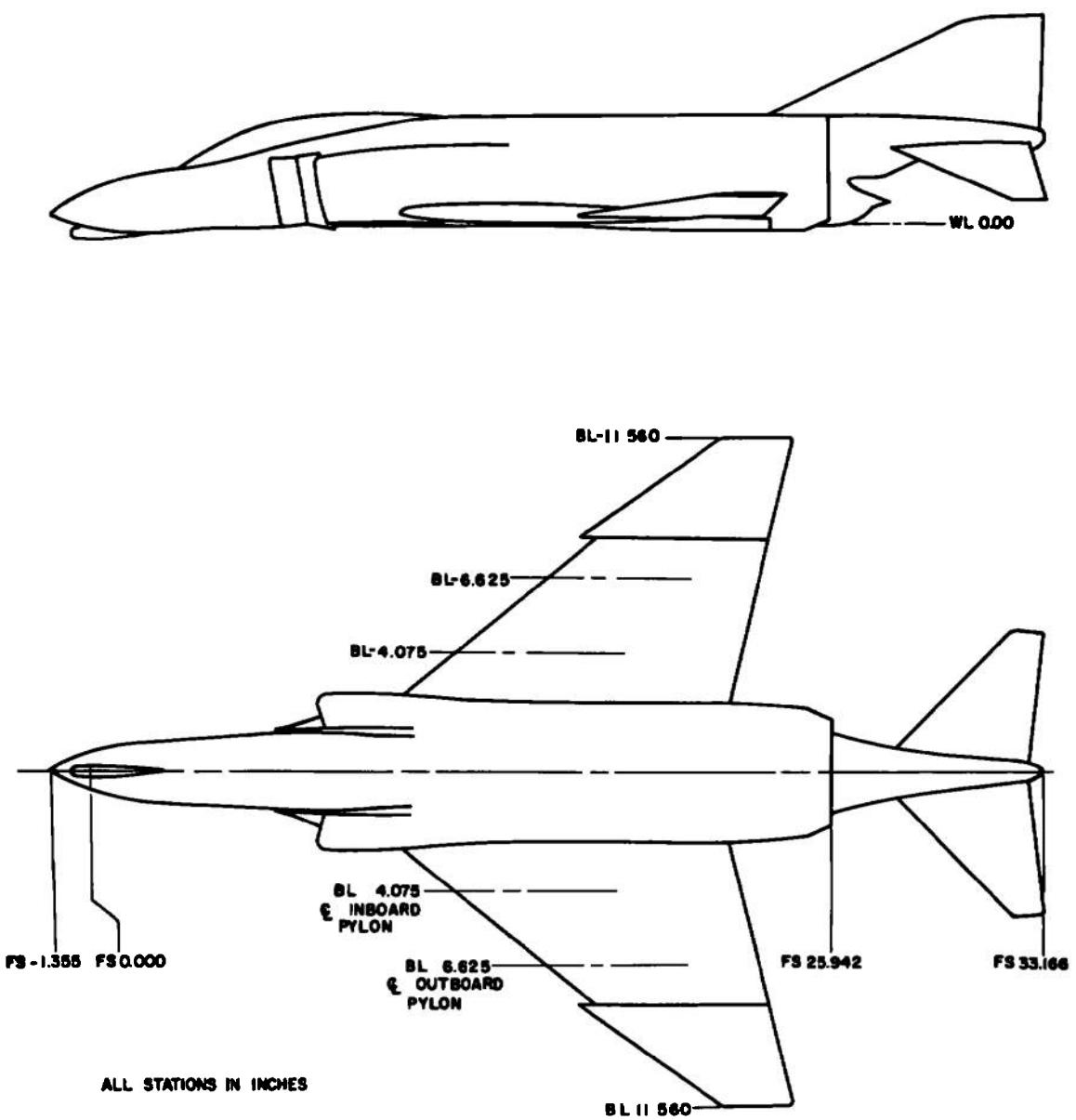
Figure 3. Sketch of the F-4C aircraft model.

FWD 30-IN. SUSPENSION POINT
FWD 14-IN. SUSPENSION POINT

W L 0.0 (Ref.)

3°

E

F

G

B

D

C
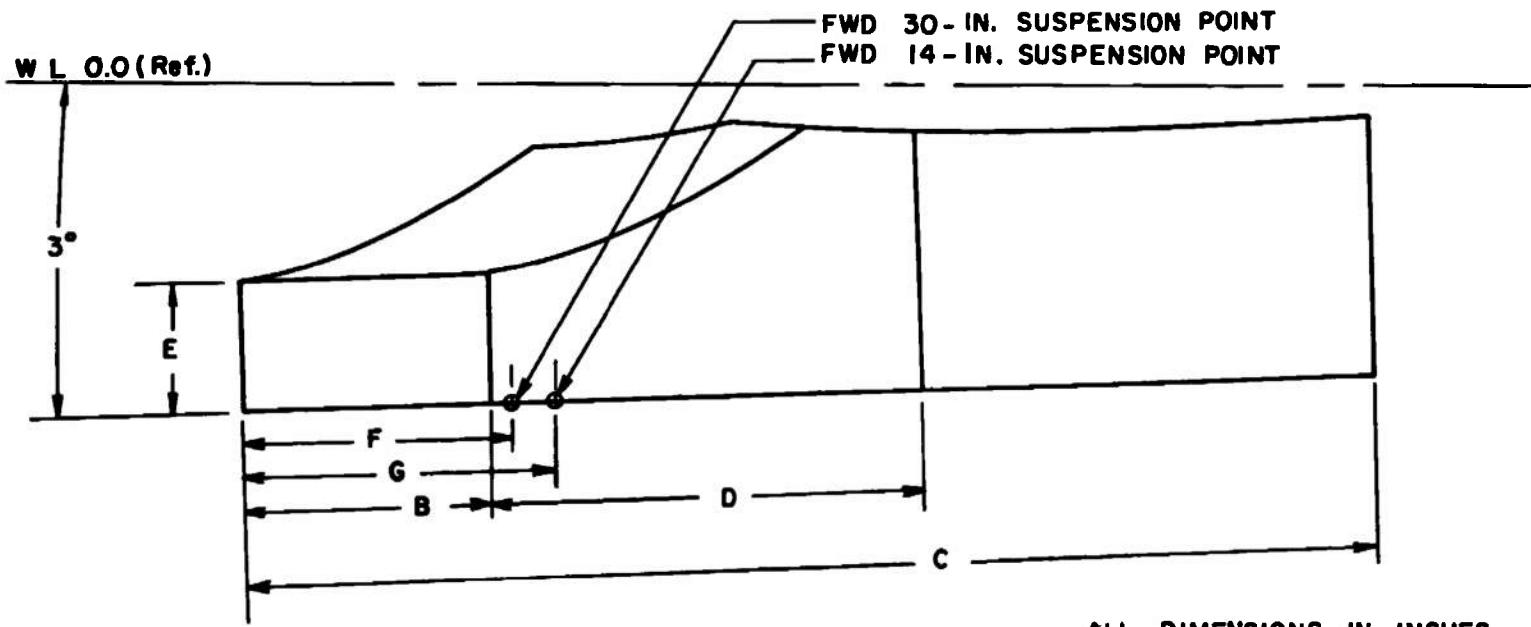
ALL DIMENSIONS IN INCHES

	INBOARD	CENTER	OUTBOARD
B	1.030	1.030	0.515
C	4.580	4.850	4.437
D	1.630	1.905	2.008
E	0.575	0.575	0.513
F	0.950	0.950	0.750
G	1.350	1.350	1.150

Figure 4. Details and Dimensions of the A-7D aircraft model pylons.

FS 16.03

5.220

BL 6.625

WING
CHORD
WL

1.0°

1.0° 0.654

0.526

0.250

1.375

FWD 14- IN. SUSPENSION POINT

7.5°

OUTBOARD PYLON

FS 11.55

5.426

BL 4.075

1.914

1.827

35.00R

WING
CHORD

1.0°

0.050R

WL

0.917

1.0°

0.700

0.250

1.279

FWD 14-IN. SUSPENSION POINT

INBOARD PYLON

LOWER FUSELAGE
CONTOUR

FS 15.67

3.874

BL 0.00

WL

0.413

0.244

0.250

0.473

FWD 30-IN.
SUSPENSION
POINT

2.5°

CENTER PYLON

ALL DIMENSIONS IN INCHES
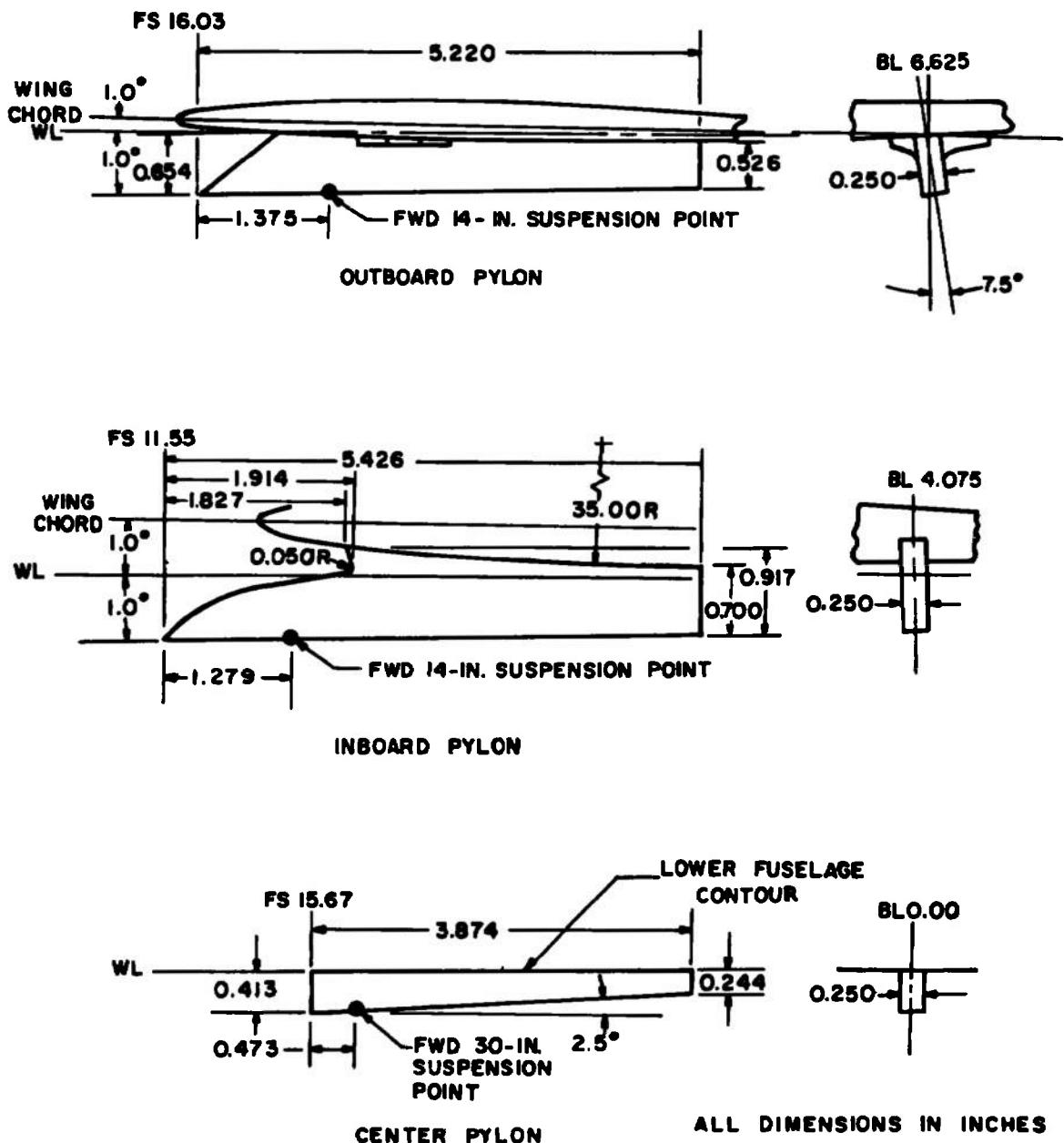
Figure 5. Details and dimensions of the F-4C aircraft model pylons.

15

NOTE: SEE FIG. 14
FOR LOCATION OF
MER ON A-7D AND
F-4C PYLONS.

ALL DIMENSIONS IN INCHES

SECTION A-A
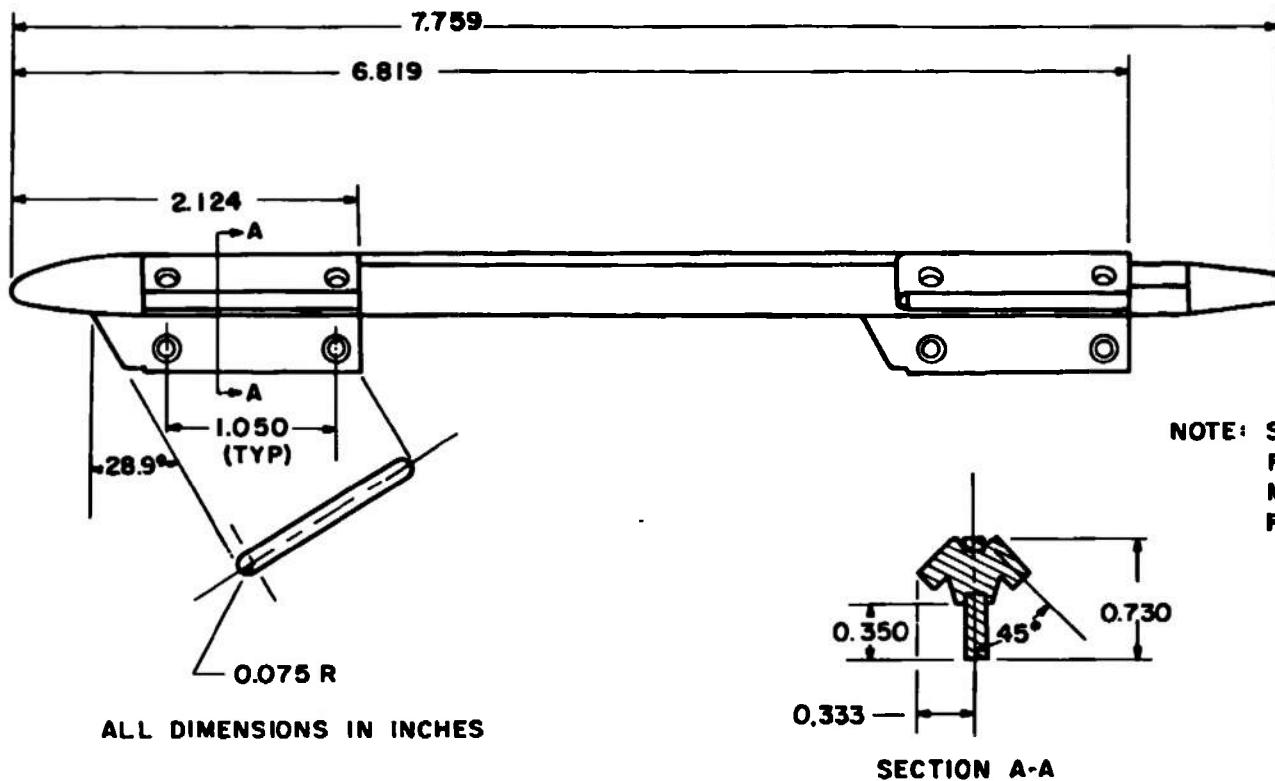
Figure 6. Details and dimensions of the A-7D and F-4C aircraft instrumented MER model.
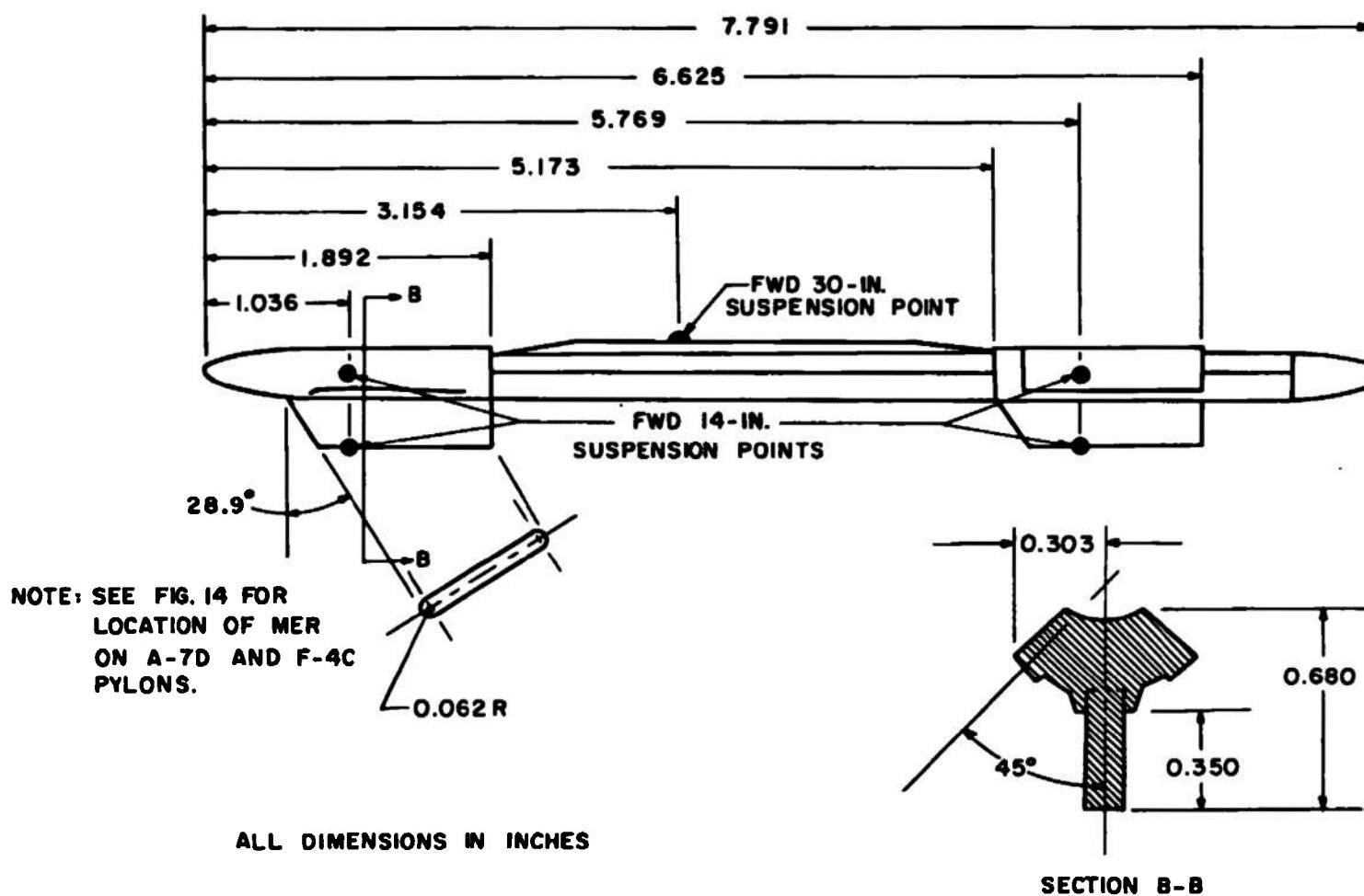
Figure 7. Details and dimensions of the A-7D and F-4C aircraft dummy MER model.
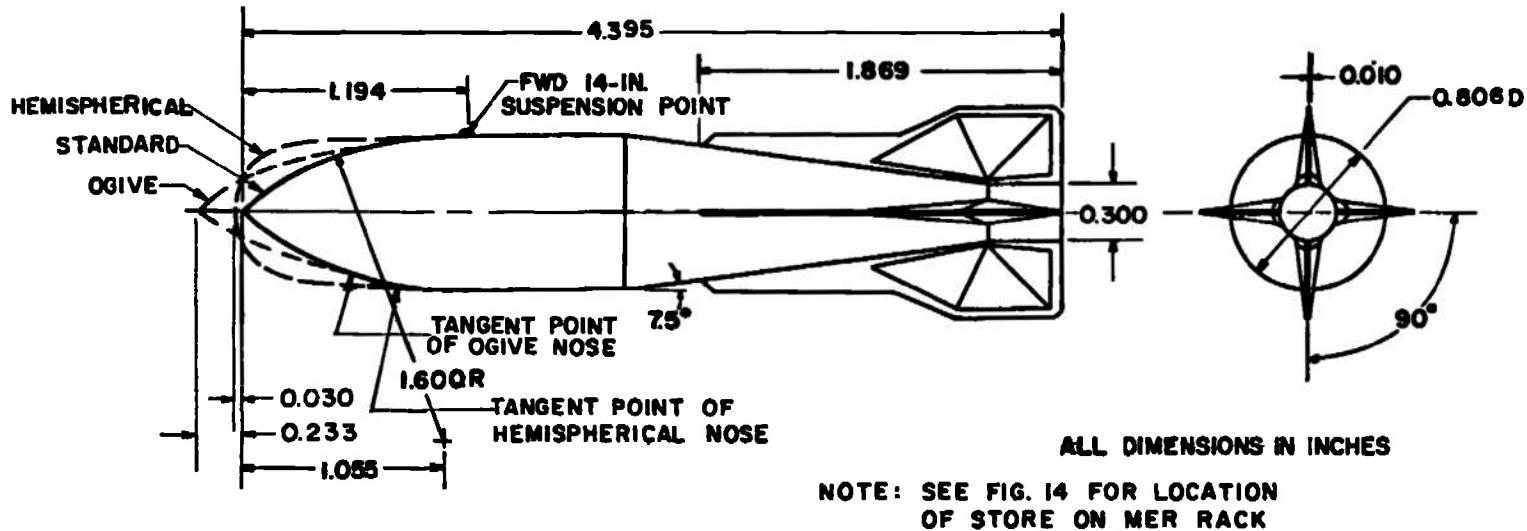
Figure 8. Details and dimensions of the M-117GP model with various nose geometries.
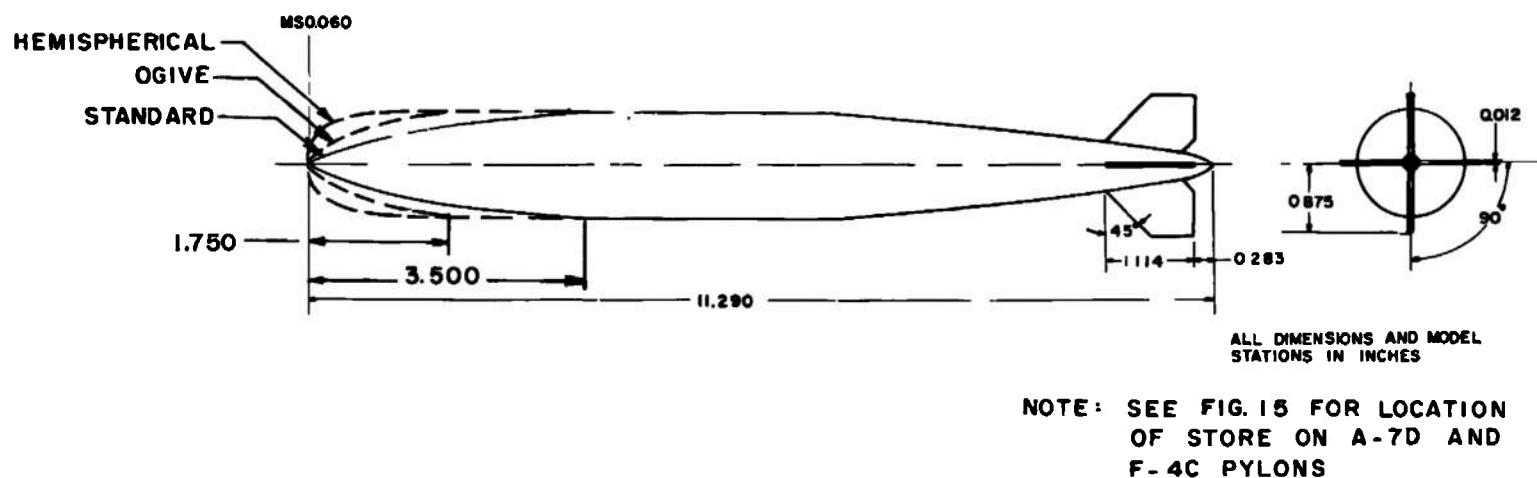
Figure 9. Details and dimensions of the 300-gal fuel tank with various nose geometries.

25°
0.002 R
SECTION A-A
18.43°
0.037
0.751
2.964
0.201
0.042

ALL DIMENSIONS IN INCHES

6.040
0.400
0.275 R
0.460 DIAM

NOTE: SEE FIG. 15 FOR LOCATION OF
STORE ON A-7D AND F-4C PYLONS.

45°
0.750
0.406
2.250
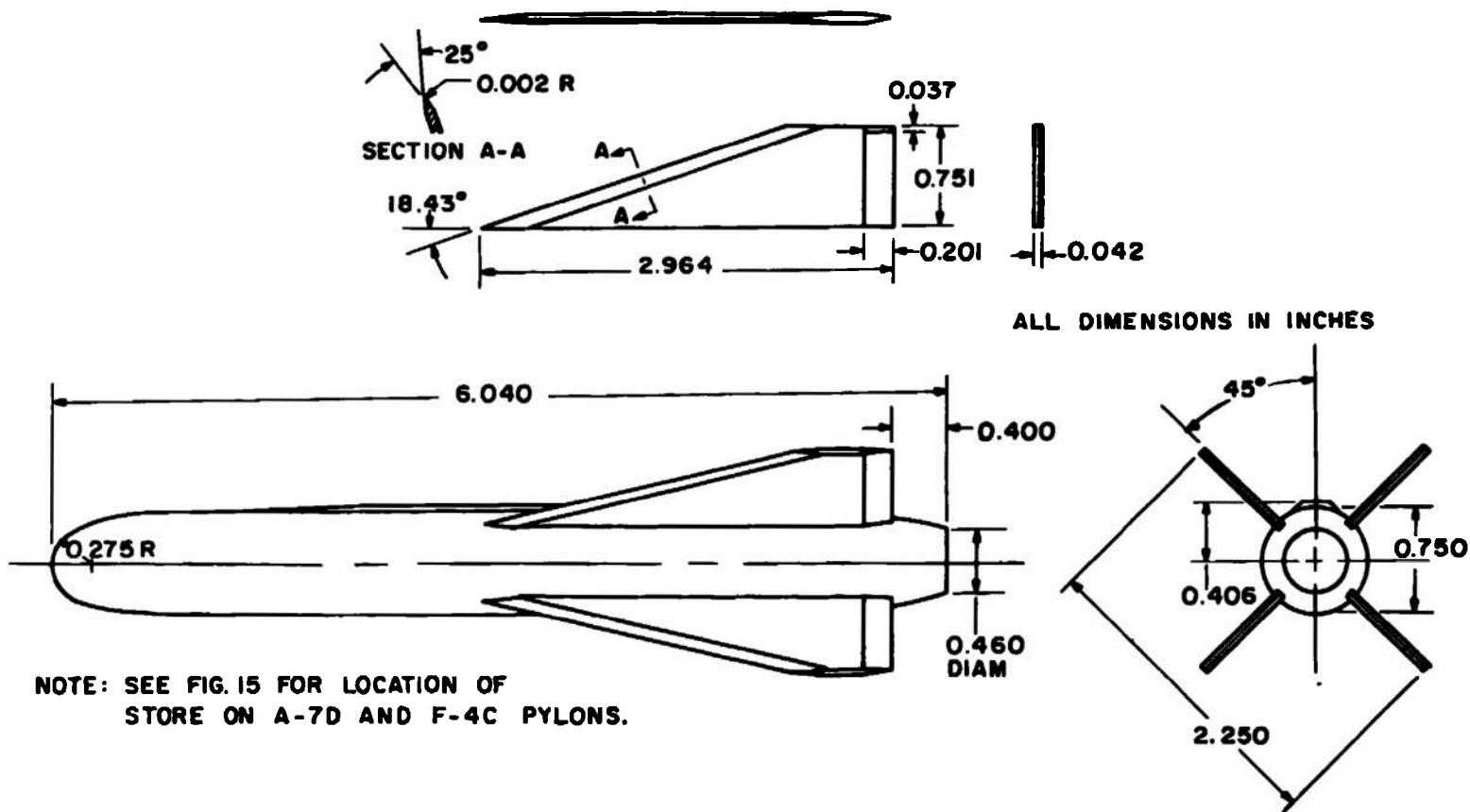
Figure 10. Details and dimensions of the AGM-62/A Walleye model.
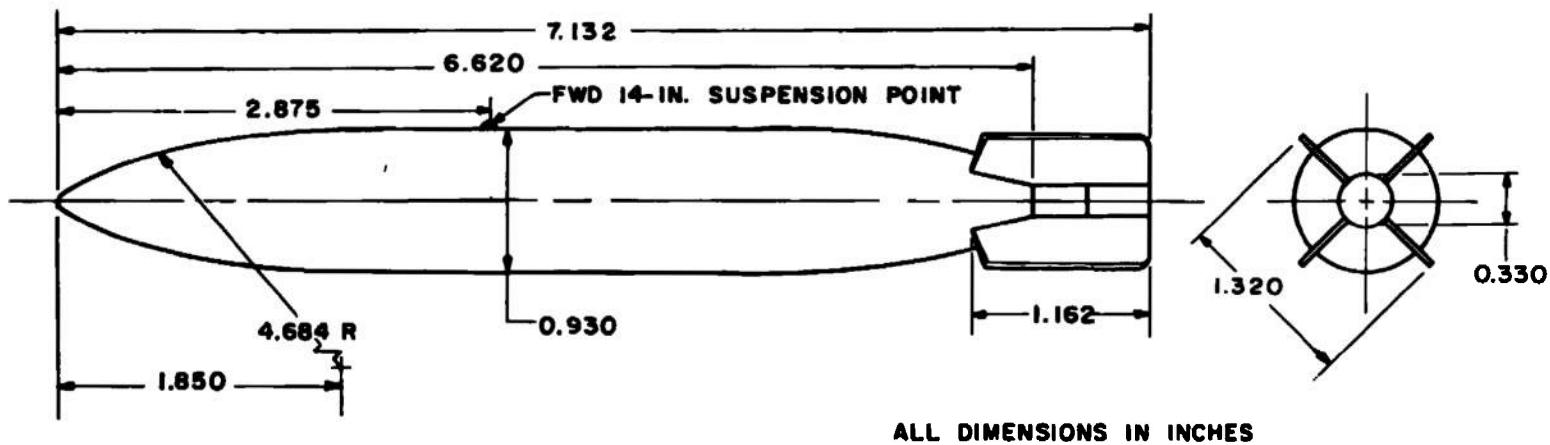
Figure 11. Details and dimensions of the BLU-1C/B model.
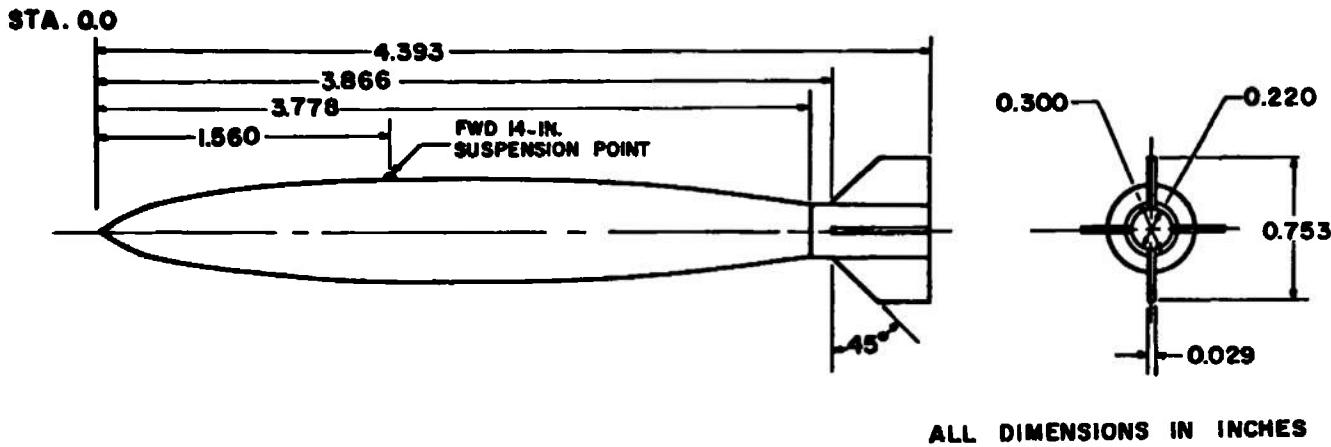
Figure 12. Details and dimensions of the MK-82GP model.
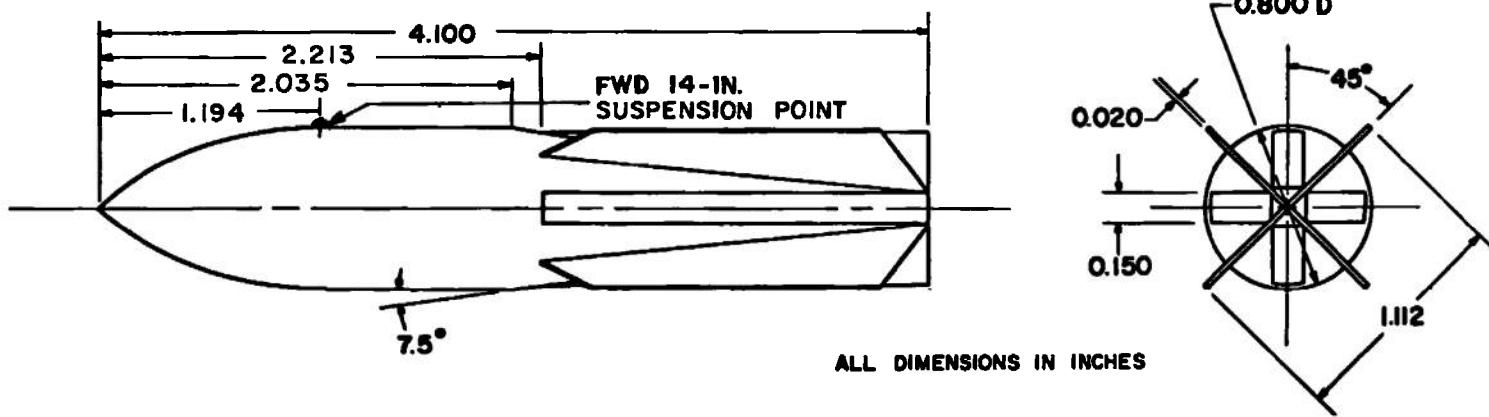
Figure 13. Details and dimensions of the M-117 retarded model.

PYLON LEADING
EDGE

"B"

0.159

BALANCE (TYP)

ADAPTER (TYP)

4.700
(TYP)

ALL DIMENSIONS IN INCHES
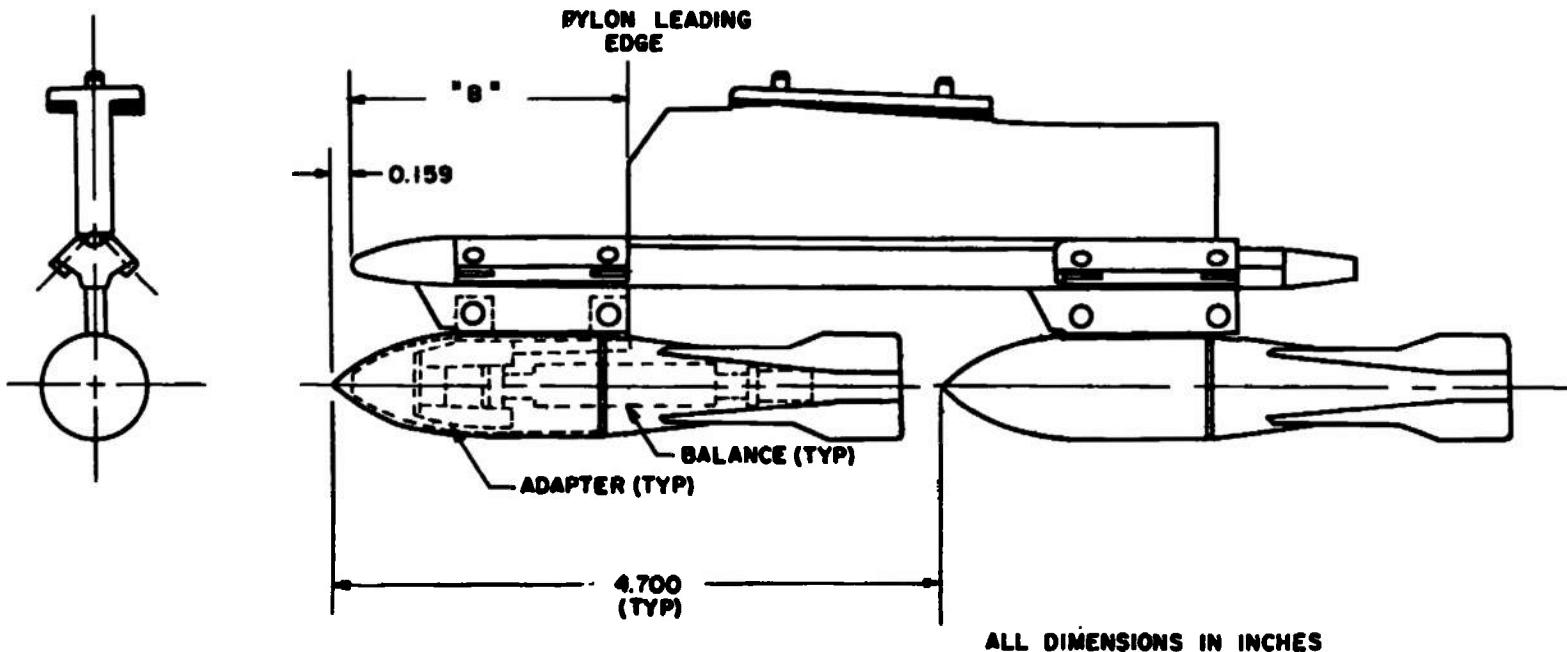
PYLON STA.	"B"	
	A-7D	F-4C
INBOARD	2.123	1.806
CENTER	2.123	3.875
OUTBOARD	2.323	2.478

Figure 14. Mounting details of the instrumented M-117GP MER-carriage store.

WING-PYLON	"A", inches			
	A - 7D		F - 4C	
	300-GAL. FUEL TANK	AGM-62/A	300-GAL FUEL TANK	AGM-62/A
INBOARD	3.075	1.675	3.196	1.746
CENTER	3.075	1.675	-	-
OUTBOARD	3.275	1.875	3.100	1.700
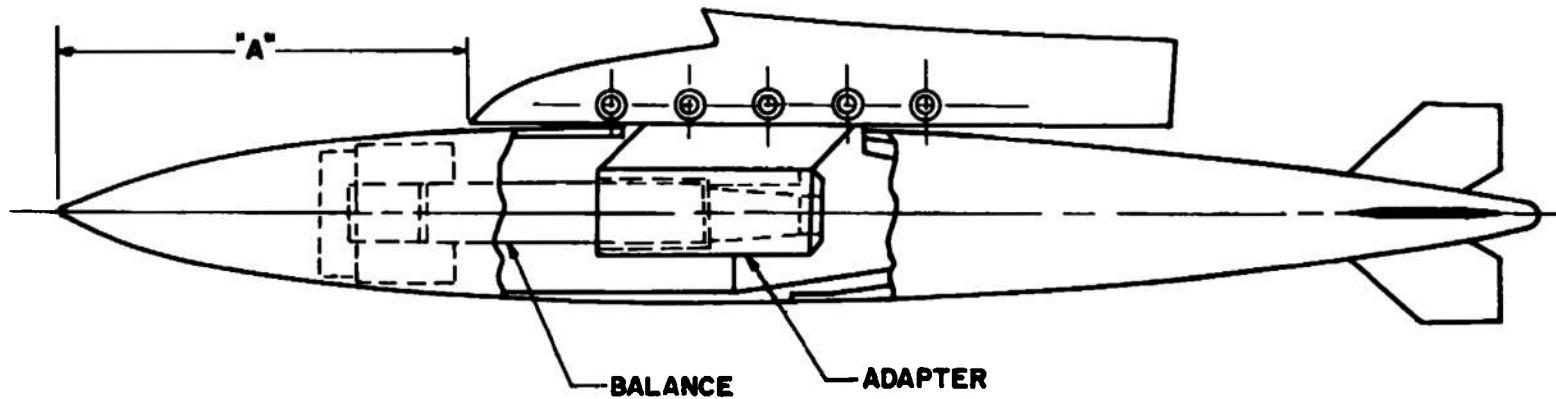
Figure 15. Mounting details of the instrumented pylon-carriage store.

AEDC
73-1799
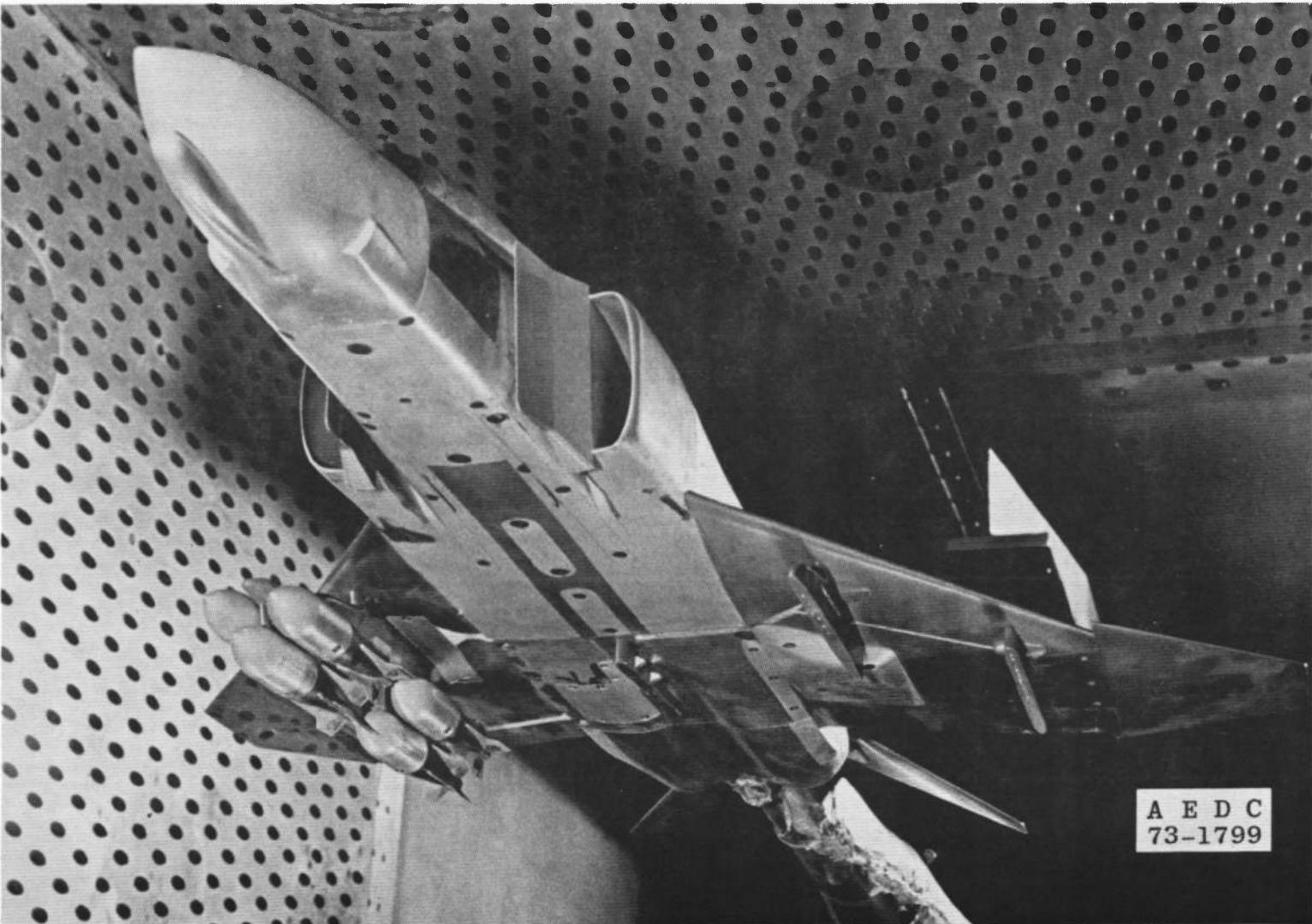
Figure 16. Tunnel installation photograph showing F-4C aircraft and M-117GP store models.

UPSTREAM

MER
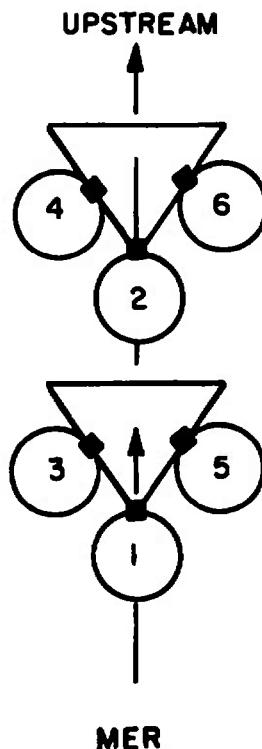
NOTE: The square indicates the orientation of the suspension lugs

TYPE RACK	STATION	ROLL ORIENTATION, deg
MER	1	0
	2	0
	3	45
	4	45
	5	-45
	6	-45

Figure 17. Schematic of the MER store stations and orientations.

27

CONFIG.

⊙	24
⊡	19
▲	1
◄	20
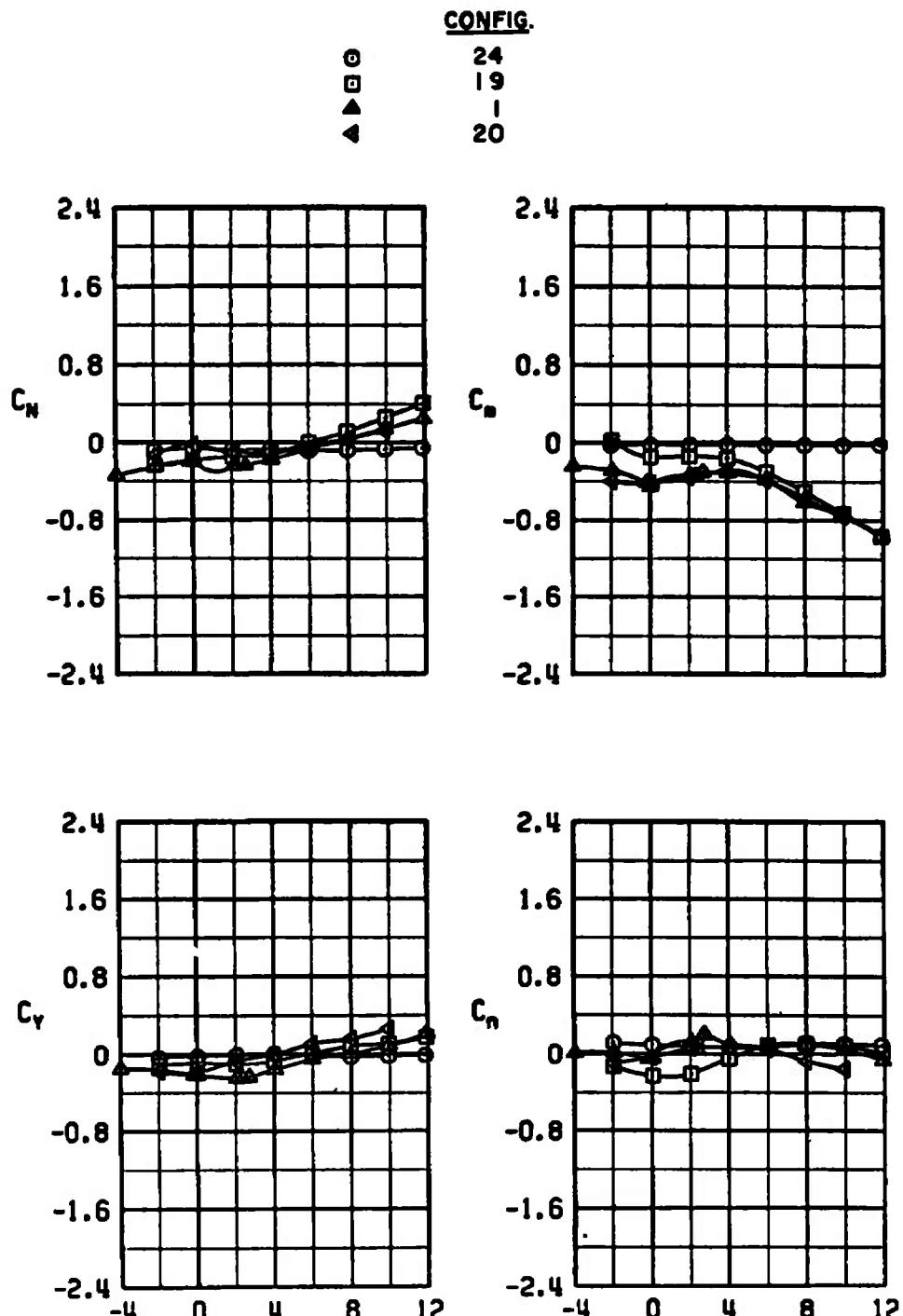
a. MER Station 1

Figure 18. Force and moment coefficients for the M-117GP on the A-7D aircraft
as a function of aircraft angle of attack, $M_\infty = 0.9$.

28
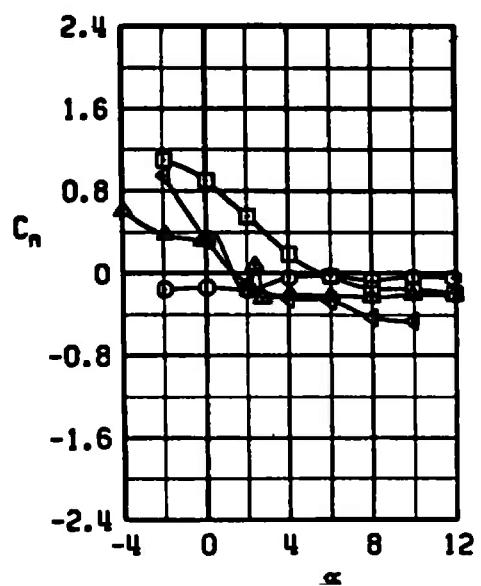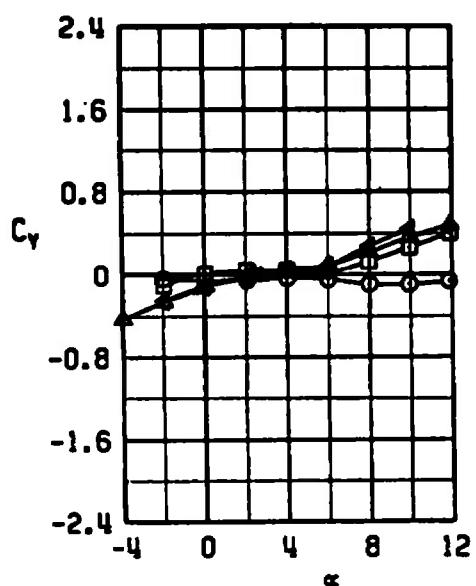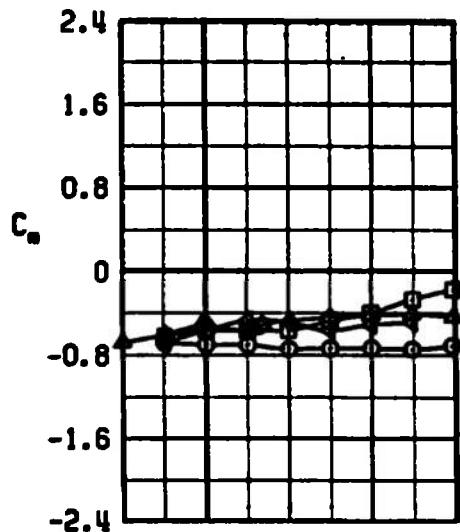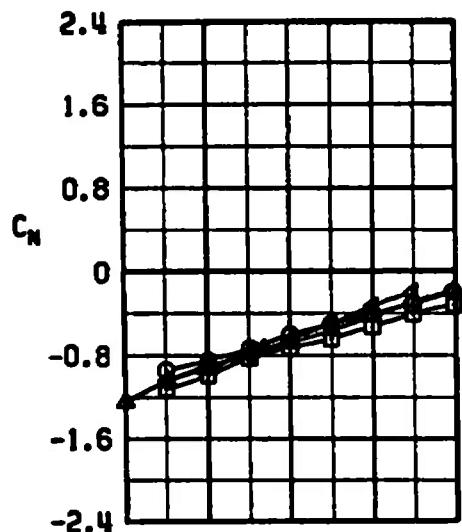
b. MER Station 2

Figure 18. Continued.
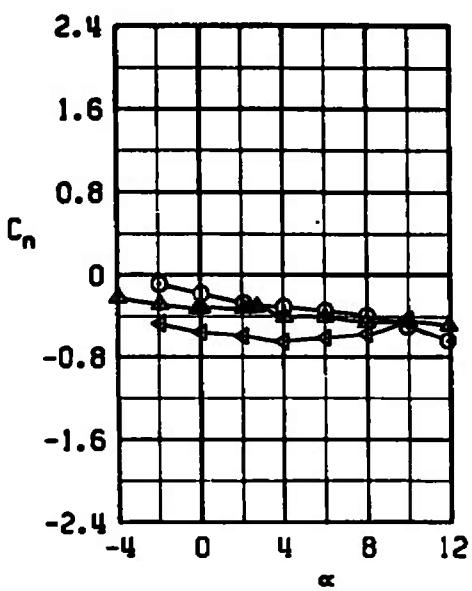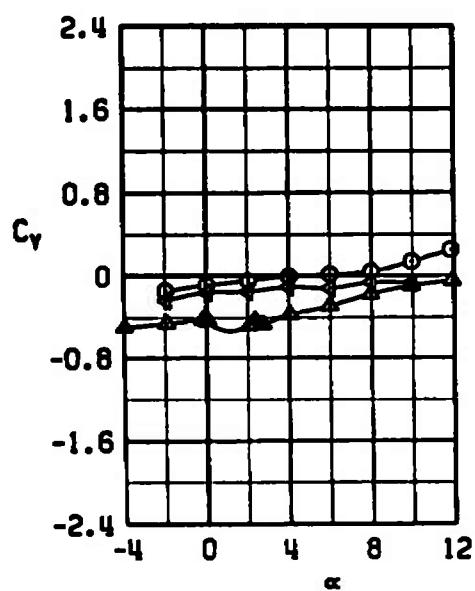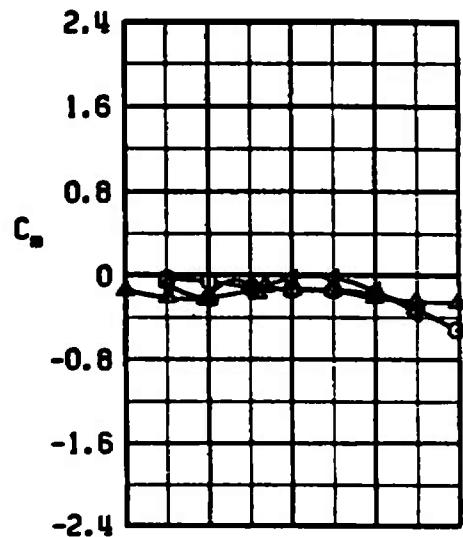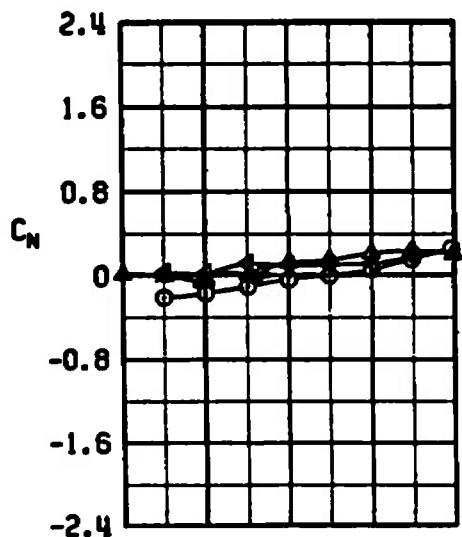
c. MER Station 3

Figure 18. Continued.

CONFIG.

☉	24
▲	1
◀	20
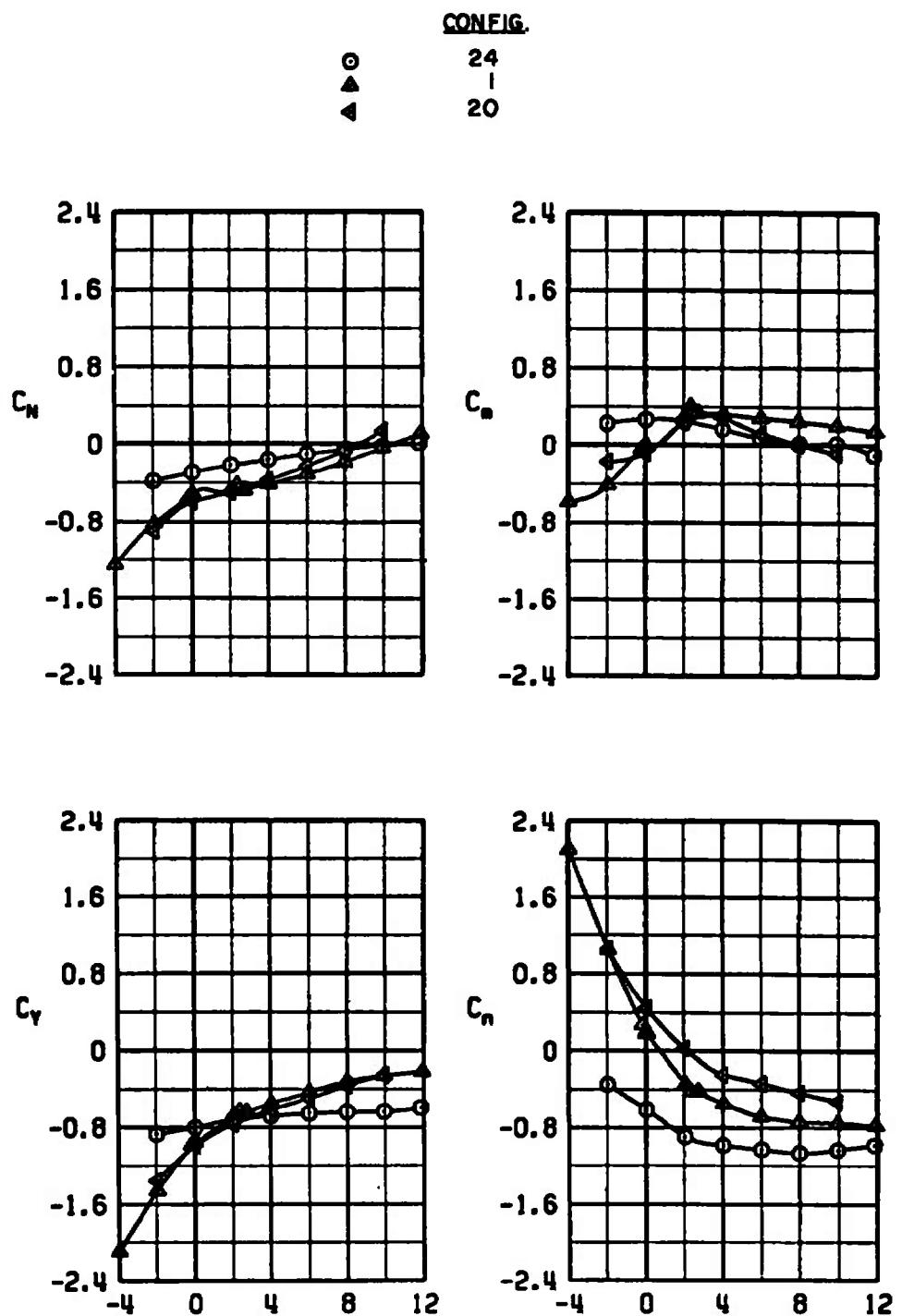
d. MER Station 4
Figure 18. Continued.

CONFIG.

⊙	24
▣	19
▲	1
◀	20
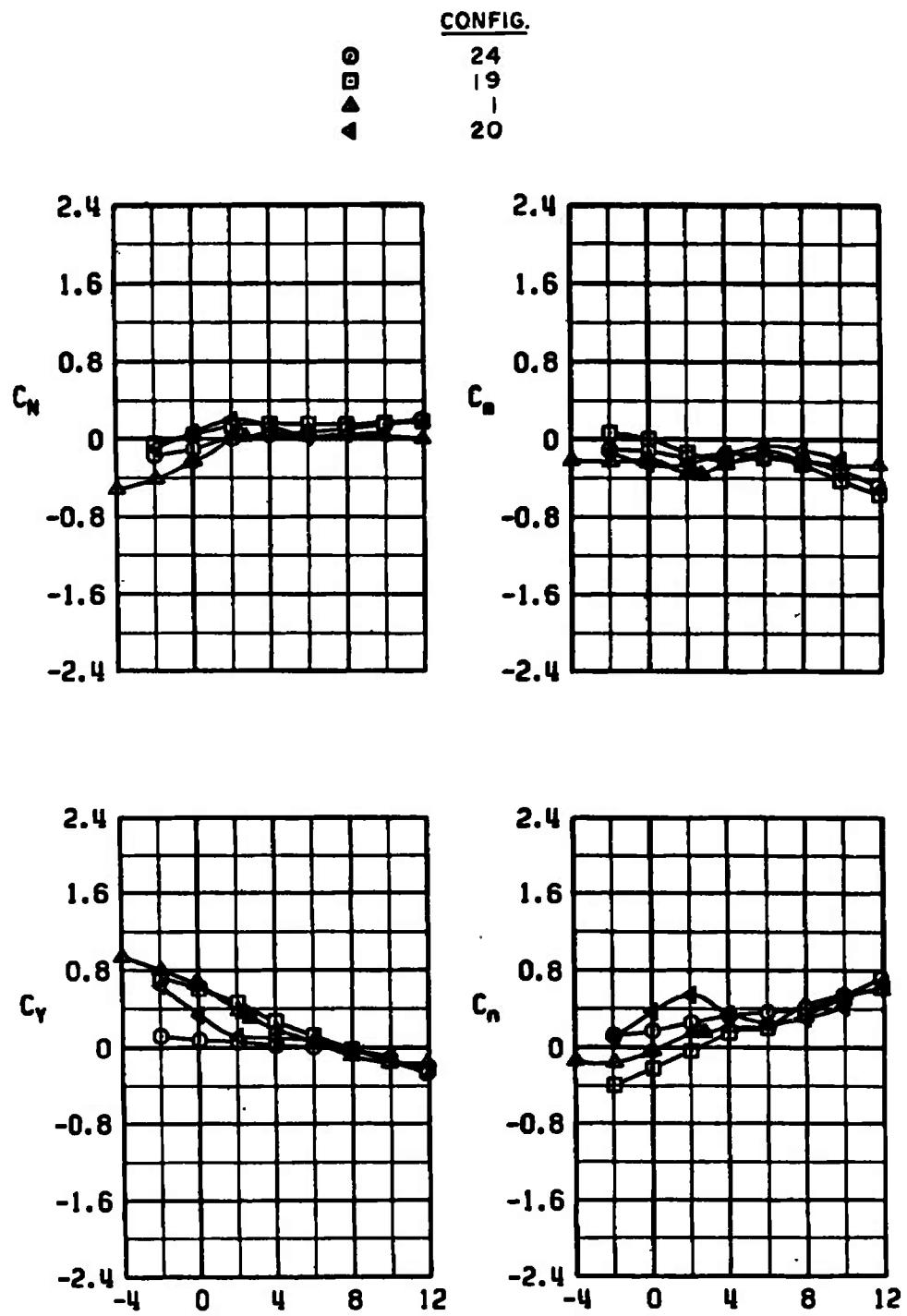
e. MER Station 5
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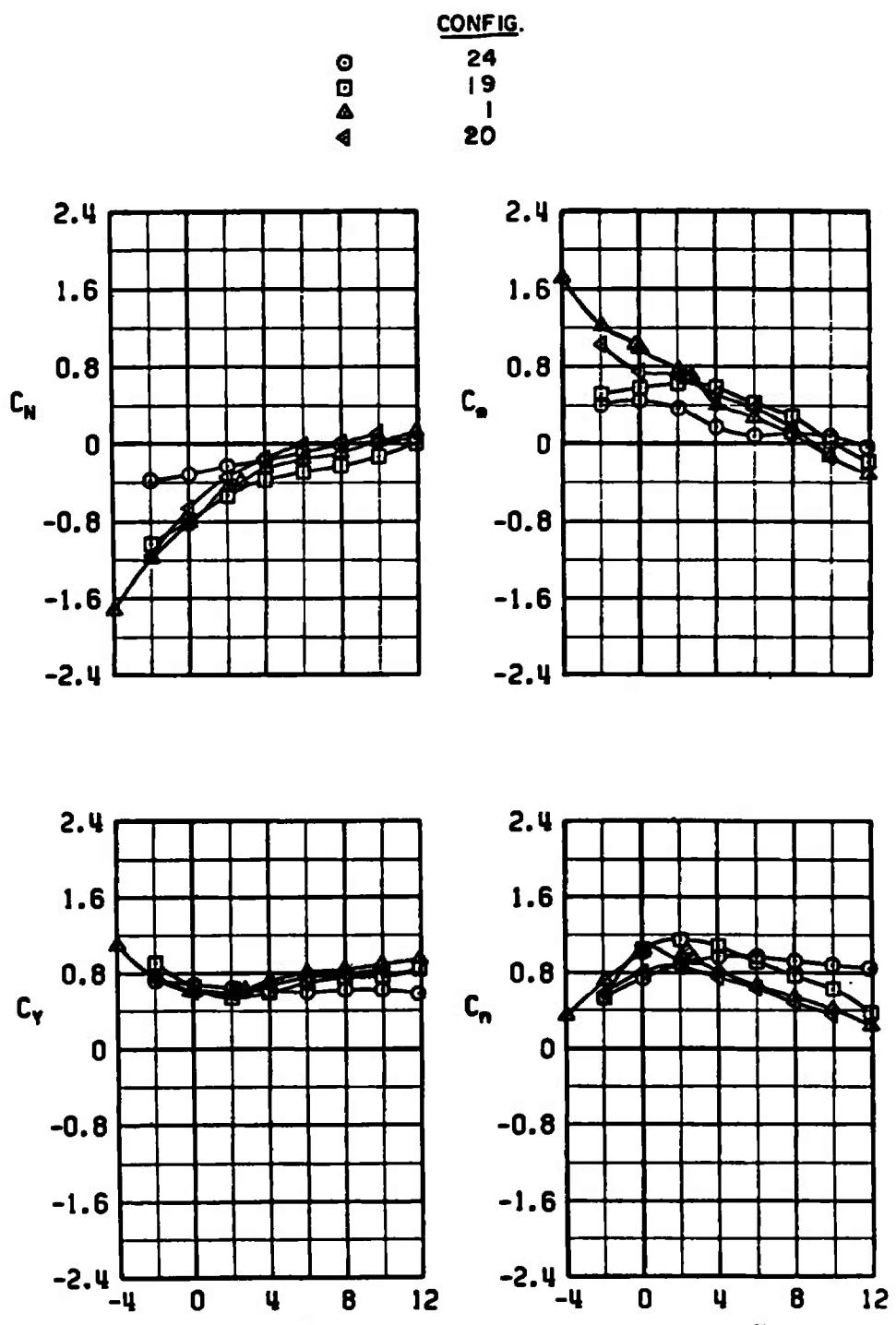
f. MER Station 6

Figure 18. Concluded.

CONFIG.

□ 47
◁ 49
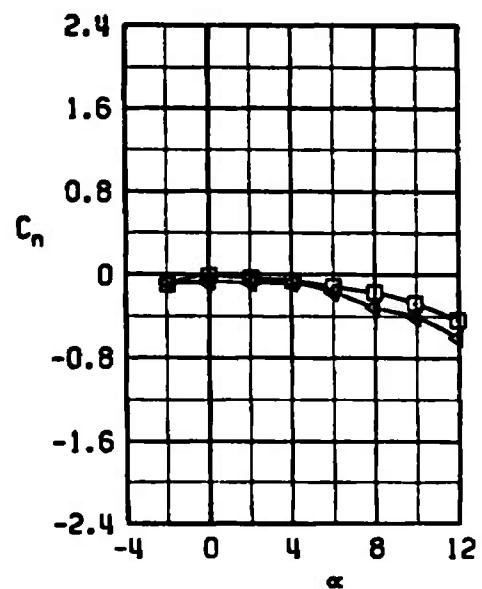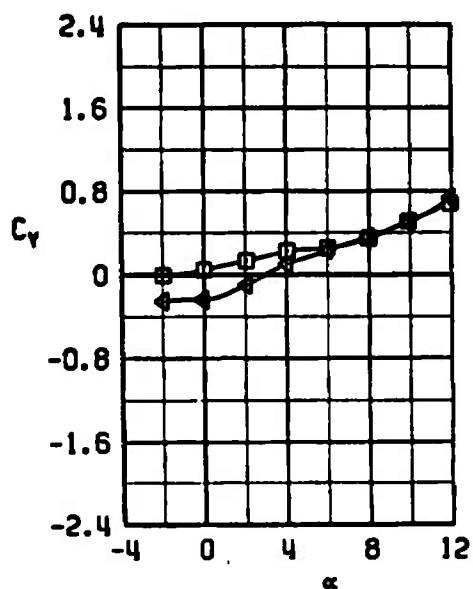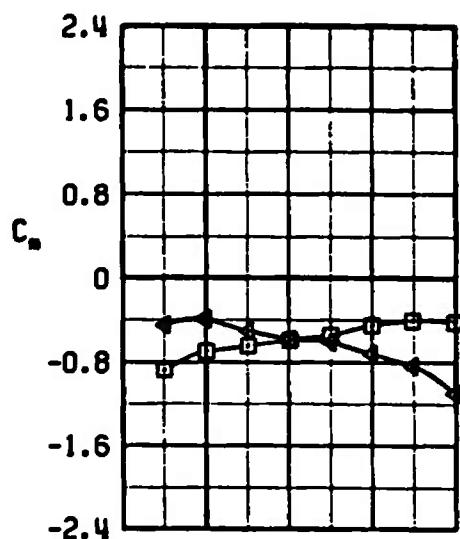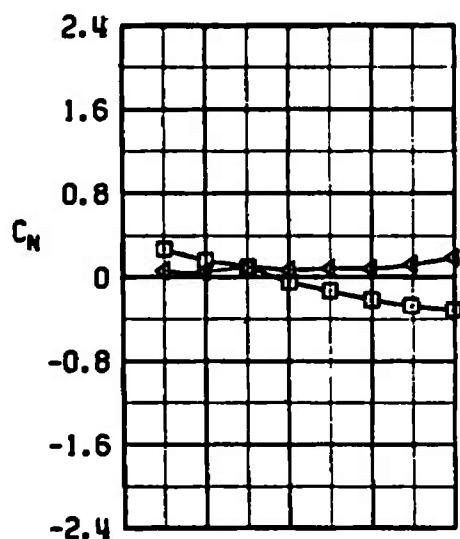
a. MER Station 1

Figure 19. Force and moment coefficients for the M-117GP on the F-4C aircraft
as a function of aircraft angle of attack, M_∞ = 0.9.
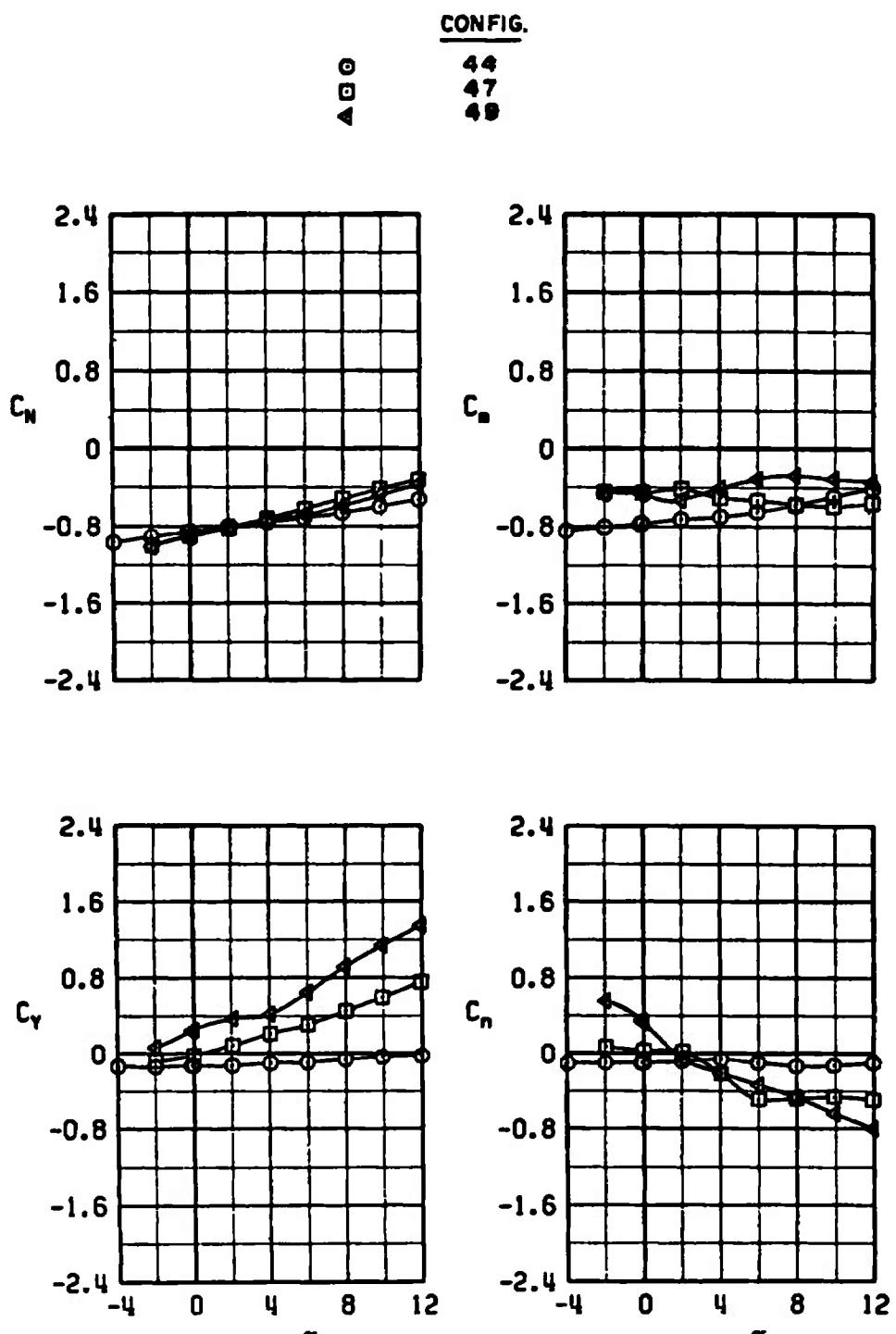
b. MER Station 2
Figure 19. Continued.

CONFIG.

☉	**44**
▫	**47**
◀	**49**
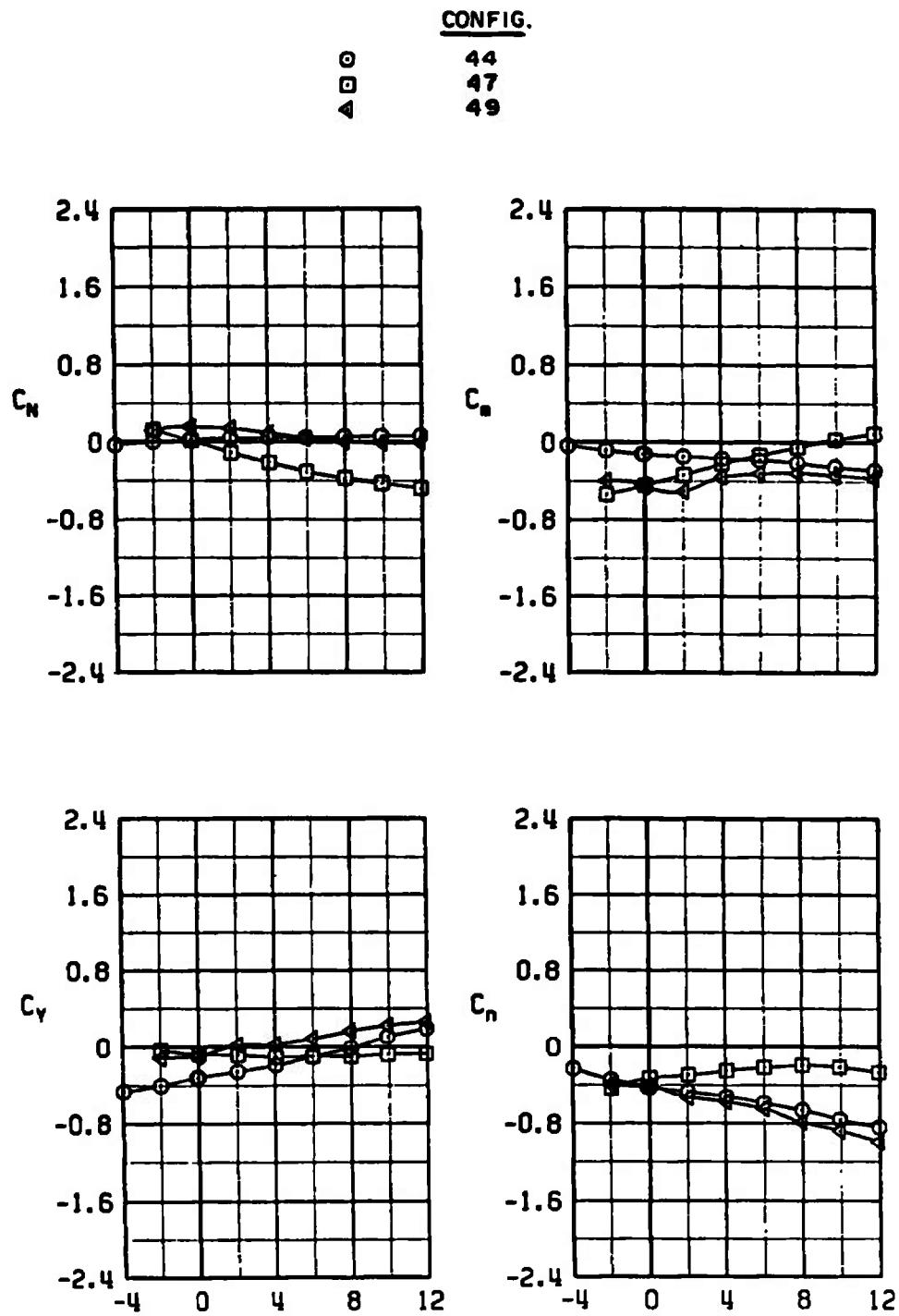
c. MER Station 3

Figure 19. Continued.
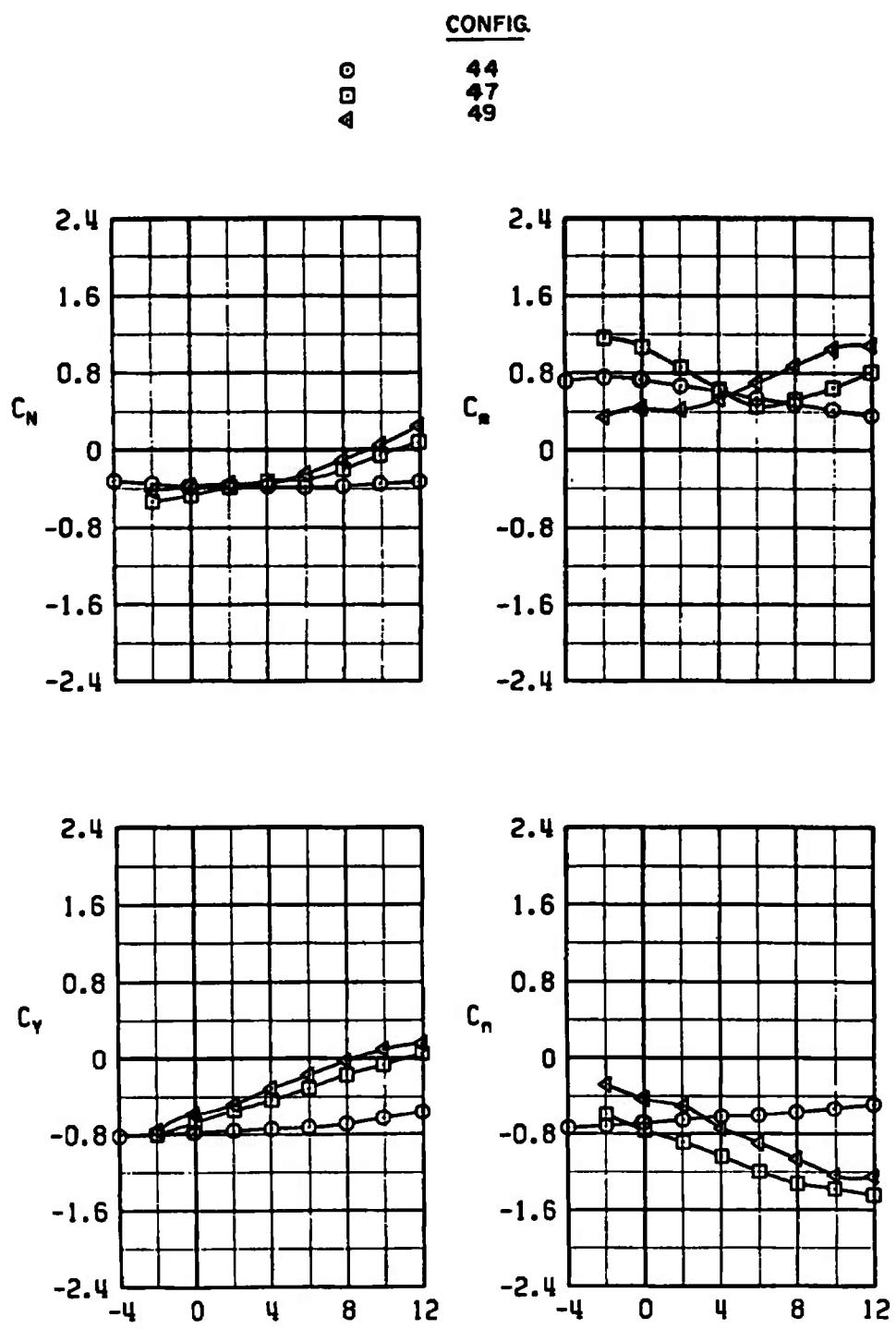
d. MER Station 4
Figure 19. Continued.
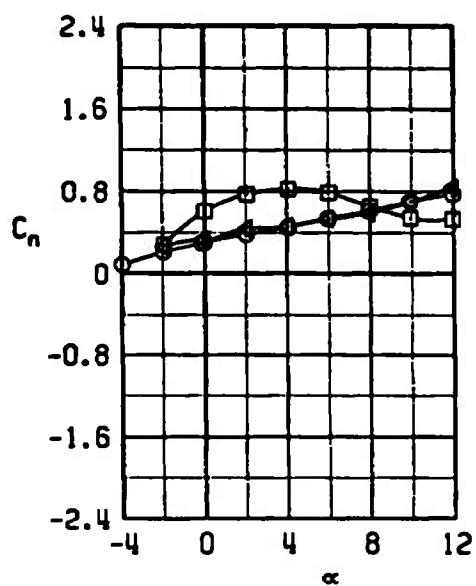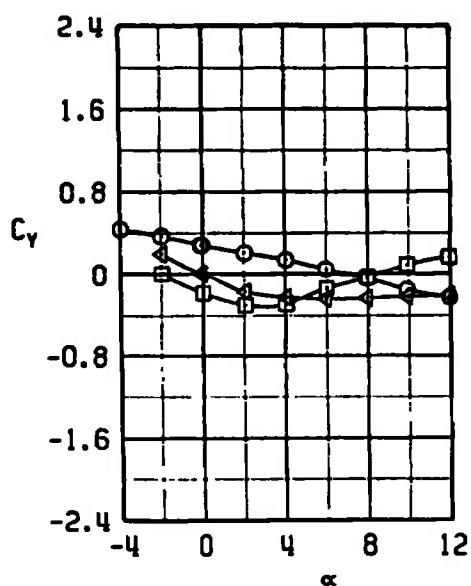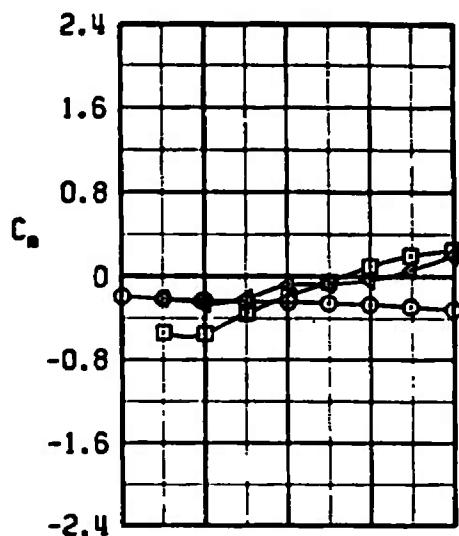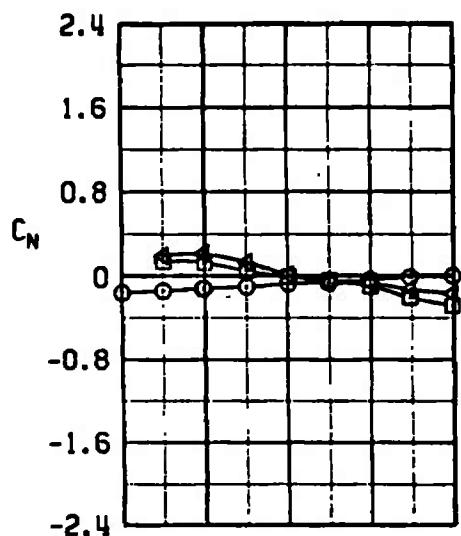
e. MER Station 5

Figure 19. Continued.

CONFIG.

⊙	44
▣	47
◄	49
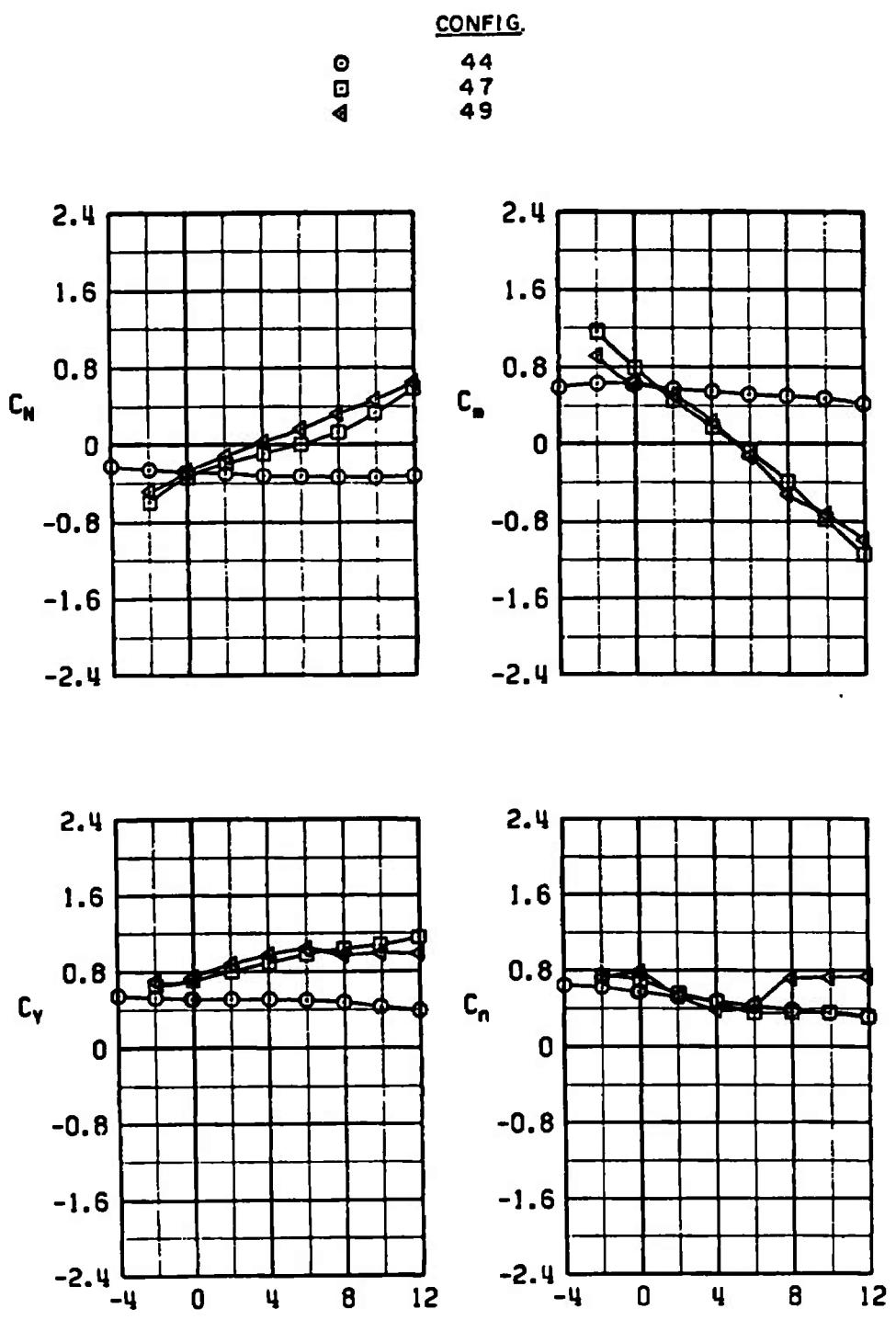
f. MER Station 6

Figure 19. Concluded.

Table 1. Aircraft/Store Reference Dimensions

Aircraft/Store	b	$\overline{c}$	s	X_{cg}	A_b
A-7D	23.238	6.504	0.9375	*	0.02014
300-gal Fuel Tank	1.325	1.325	0.009575	4.775	---
AGM-62/A	0.750	0.750	0.003068	3.3750	---
M-117GP	0.806	0.806	0.003548	1.5450	---
BLU-1C/B	0.925	0.925	0.004667	3.2250	---

*Model Station   22.968
   Waterline   5.000
  Buttock Line   0.000

Table 2. Identification of Test Configurations and Test Conditions for the A-7D Aircraft

CONFIG. NO.	LEFT WING 1	2	3	⊄	5	6	RIGHT WING 7	8	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER 0.50	0.70	0.90	1.05	1.20	1.60	2.00
1		●					⋁⋁		$[300IS]_2 + [MER + M-117IS^{1-6}]_7$	0	12	13	27	35	41	389, 393	---
										4	---	23	28	36	42	390	---
										-4	---	25	30	38	44	392	---
										8	---	111	112	113	114	391	---
										-8	---	24	29	37	43	---	---
2			○		○				$+[M-117R]_{3,6}$	0	---	47	50	49	48	396, 399	---
3			○		○				$+[BLU]_{3,6}$		---	54	55	57	103	402	---
4	○		○		○			○	$+[300]_{3,6}$		---	60	61	62	95	405	---
5									$+[M-117R]_{1,8}$		---	65	66	67	68	---	---
6		●	⋁⋁		⋁⋁		⋁⋁		$[300IS]_2 + [MER + M-117IS^{1-6}]_7$ $+[MER + MK-82^{1-6}]_{3,8}$		---	77	78	79	80	408	---
7	○							○	$+[300]_{1,8}$		---	83	84	85	86	411	---
8	○		○		○			○	$+[M-117R]_{1,3,6,8}$		---	98	99	---	100	---	---
9									$+[BLU]_{1,3,6,8}$		---	106	107	---	108	---	---
10									$+[300]_{1,3,6,8}$		---	89	90	---	91	414	---

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT — PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 2. Continued

CONFIG. NO.	LEFT WING 1	2	3	C̶L̶	6	RIGHT WING 7	8	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER 0.50	0.70	0.90	1.05	1.20	1.60	2.00
11		●				▼▼		$[300IS+BA1]_2$ $+[MER+M\text{-}117IS^{1-6}+BA1]_7$	0	117	118	127	130	133	---	---
									4	---	125	128	131	134	---	---
									-4	---	126	129	132	135	---	---
12		●				▼▼		$[300IS+BA2]_2$ $+[MER+M\text{-}117IS^{1-6}+BA2]_7$	0	138	139	142	145	148	---	---
								$[300IS+BA2]_2$ $+[MER+M\text{-}117IS^{1-6}+BA2]_7$	4	---	140	143	146	149	---	---
									-4	---	141	144	147	150	---	---
13		●				▼▼		$[WEIS]_2 + [MER+M\text{-}117IS^{3-6}]_7$	0	155	156	162	167	174	419	---
									4	---	157	163	188	175	421	---
									-4	---	158	164	172	176	422	---
									8	---	159	165	173	177	423	---
									-8	---	180	168	---	---	---	---
14		●	●		●			$+[M\text{-}117R]_{3,6}$	0	181	182	183	---	184	426	---

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
O DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 2. Continued

| CONFIG. NO.	1	2	3	℄	6	7	8	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
										0.50	0.70	0.90	1.05	1.20	1.60	2.00
15			O		O			$+[BLU]_{3,6}$	0	187	188	189	---	190	430	---
16		●	O		O			$+[300]_{3,6}$		193	194	195	---	196	433	---
17			●					$[300IS]_3 + [MER + M\text{-}117IS^{5,6}]_7$		200	201	206	210	213	437	---
									4	---	203	207	211	214	438	---
									-4	---	205	209	212	215	439	---
18		O			O			$[300IS]_3 + [MER + M\text{-}117^{5,6}]_7 +[300]_{2,6}$	0	---	218	219	---	220	442	---
19								$[WEIS]_3 + [MER + M\text{-}117IS^{1,2,5,6}]_6 + [M\text{-}117R^{3,4}]_6$	0	292	293	296	299	302	459	---
									4	---	294	297	300	303	460	---
									-4	---	295	298	301	304	461	---
20	●							$[300IS]_1 + [MER + M\text{-}117IS^{1\text{-}6}]_8$	0	262	283	267	272	276	470	---
									4	---	264	269	273	277	471	---

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 2. Continued

CONFIG. NO.	LEFT WING — RIGHT WING (1 2 3 ℭ 6 7 8)	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
				0.50	0.70	0.90	1.05	1.20	1.60	2.00
20		$[300IS]_1 + [MER + M\text{-}117IS^{1-6}]_8$	8	---	265	270	274	---	472	---
			-4	---	266	271	275	278	473	---
21		$[300IS]_1 + [MER + M\text{-}117IS^{1-6}]_8$ $+ [300]_{3,6}$	0	---	281	282	---	283	477	---
22		$+ [300]_7$		---	288	287	---	286	480	---
23		$[TMER + M\text{-}117IS^{1-6}]_ℭ$		333	334	337	340	352	381	---
			4	---	335	338	341	353	382	---
			8	---	336	339	342	354	---	---
24		$[MER + M\text{-}117IS^{1-6}]_ℭ$	0	363	364	365	368	371	376	---
			4	---	372	366	369	370	378	---
25		$[TMER + M\text{-}117IS^{1-6}]_ℭ$ $+ [300]_{3,8}$	0	---	357	358	359	360	385	---
26		$[WEIS]_1 + MER + BLUIS^{1,4,6}]_7$		225, 229	230	232	241	245	446	---
			4	---	236	233	242	246	447	---
			8	---	239	234	243	247	449	---

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 2. Concluded

CONFIG. NO.	1	2	3	⊄	6	7	8	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
										0.50	0.70	0.90	1.05	1.20	1.60	2.00
26	●					▼		$[WEIS]_1 + [MER + BLUIS^{1,4,6}]_7$	-4	---	240	235	244	248	450	---
27		O			O	▼		$+ [M\text{-}117R]_{2,6}$	0	---	251	252	---	253	453	---
28		O			O			$+ [BLU]_6 + [300]_2$		---	256	257	---	258	456	---
29								Basic Data		310	313	316	318	320	464	---
									4	312	314	317	319	321	465	---
									8	326	325	324	323	322	466	---
60								$[MER + M\text{-}117R^{1\text{-}6}]_{2,7}$	0		(M_∞ = 0.80) 307					

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
O DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 3. Identification of Test Configurations and Test Conditions for the F-4C Aircraft

LEFT WING   RIGHT WING

| CONFIG. NO.	1	2	5	8	9	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
								0.50	0.70	0.90	1.05	1.20	1.60	2.00
30				●		$[300IS]_8$	0	508	509, 517	510	506	507	849	---
							4	---	518	522	528	533	850	---
							-4	---	520	525	530	534	851	---
							8	---	519	524	529	---	---	---
							-8	---	521	526	531	---	---	---
31					○	$+[M\text{-}117R]_9$	0	---	537	538	---	539	---	---
32					○	$+[300]_9$		---	542	543	---	544	854	---
33						$[300IS]_{8,\,FWD}$		---	547	548	549	550	---	---
34						$[300IS]_{8,\,AFT}$		---	553	554	555	558	---	---
35					●	$[300IS]_9$	0	560	561	569	---	563	859	---
							4	---	568, 569	---	---	---	860	---
							-4	---	---	---	---	---	862	---
36				○		$+[M\text{-}117R]_8$	0	---	582	583	---	584	---	---
37						$[300IS]_9 + [BLU]_8$		---	577	578	---	579	---	---
38						$+[300]_8$		---	572	573	---	574	---	---
39						$[300IS]_{9,\,FWD}$		---	587	588	---	---	---	---

NOTE: $\alpha = -4$ TO 12 DEG FOR ALL MACH NUMBERS
● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 3. Continued

CONFIG. NO	LEFT WING / RIGHT WING 1	2	5	8	9	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER 0.50	0.70	0.90	1.05	1.20	1.60	2.00
44			●			$[MER + M\text{-}117IS^{2\text{-}6}]_5$ $+[M\text{-}117I]_5$	0	667	668	671	676	679	809	---
							4	---	669	672	677	680	810	---
							8	---	670	673	678	---	---	---
45		○				$+[300]_2$	0	---	683	664	---	685	813	---
46		○		○		$+[300]_{2, 8}$	0	---	688	689	---	690	816	---
47				●		$[MER + M\text{-}117IS^{1\text{-}6}]_8$	0	634	635	640	646	652	789	---
							4	---	636	641	647	653	790	---
							-4	---	638	643	649	654	791	---
							8	---	637	642	648	---	---	---
							-8	---	639	644	650	---	---	---
48		○				$+[300]_5$	0	---	656	657	---	658	794	---
49					●	$[MER + M\text{-}117IS^{1\text{-}6}]_9$	0	694	695	700	705	710	798	---

NOTE: $\alpha = -4$ TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT — PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

Table 3. Continued

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LEFT WING   RIGHT WING
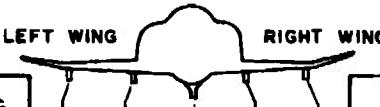
CONFIG NO	1	2	5	8	9	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
								0.50	0.70	0.90	1.05	1.20	1.50	2.00
49						$[MER + M\text{-}117IS^{1\text{-}6}]_9$	4	---	696	701	706	711	799	---
							-4	---	697	702	707	712	800	---
							8	---	699	703	708	---	---	---
							-8	---	698	704	709	---	---	---
50				o		$[M\text{-}117R]_8$	0	---	715	716	---	717	803	---
51				o		$[300]_8$		---	721	722	---	723	806	---
52						$[WEIS]_9$		593	594	600	603	806	---	---
							4	---	595	601	604	607	---	---
							-4	---	598	802	605	608	---	---
53				o		$[WEIS]_9 + [M\text{-}117R]_8$	0	---	611	812	---	613	836	---
54				o		$[300]_8$		---	816	617	---	818	839	---
55						$[WEIS]_{9, FWD}$		---	621	622	623	624	842	---
56						$[WEIS]_{9, AFT}$		---	627	628	829	630	845	---
57						$[MER + BLUIS^{1, 4, 6}]_8$		762	759	763	769	774	780	---
							4	---	760	764	770	775	781	---

NOTE: $\alpha = -4$ TO 12 DEG FOR
ALL MACH NUMBERS
● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT —— PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS
ARE TEST RUN IDENTIFICATION
NUMBERS

Table 3. Concluded

LEFT WING | RIGHT WING

CONFIG NO	1	2	5	8	9	CONFIGURATION DESCRIPTION	ψ	MACH NUMBER						
								0.50	0.70	0.90	1.05	1.20	1.60	2.00
57						$[MER+BLUIS^{1,4,6}]_8$	-4	---	761	765	771	776	782	---
							8	---	---	766	772	---	---	---
							-8	---	---	767	773	---	---	---
59						$[MER+BLUIS^{1,4,6}]_9$	0	727	728	729	730	731	---	---
80						$[WEIS]_8$		736	737	740	743	746	822	---
							4	---	738	741	744	747	823	---
							-4	---	739	742	745	748	824	---
81						$[WEIS]_{8,WFD}$	0	---	751	752	753	754	819	---
82						$[WEIS]_{8,AFT}$		---	---	---	---	---	827	---

NOTE: α = -4 TO 12 DEG FOR ALL MACH NUMBERS

● INSTRUMENTED STORE
○ DUMMY STORE
SUPERSCRIPT — MER STATION LOCATION
SUBSCRIPT — PYLON STATION

NOTE: ABOVE NUMBERS IN COLUMNS ARE TEST RUN IDENTIFICATION NUMBERS

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NOMENCLATURE

A_b Aircraft base area, ft^2

AFT   Aft longitudinal shift of store relative to standard carriage position on pylon (12 in. full scale)

BA1   Store nose bluntness adaptor, ogive shape

BA2   Store nose bluntness adaptor, hemispherical shape

BLU   BLU-1C/B finned fire bomb

b   Store model reference dimension, in., model scale

C_m Pitching-moment coefficient (referenced to the store cg) measured in the store body axis system, pitching moment/$q_\infty S\bar{c}$. The positive pitching-moment vector is coincident with the positive Y_B axis

C_N Normal-force coefficient measured in the store body axis system, normal force/$q_\infty S$, positive in the negative Z_B direction

C_n Yawing-moment coefficient (referenced to store cg) measured in the store body axis system, yawing moment/$q_\infty Sb$. The positive yawing-moment vector is coincident with the positive Z_B axis

C_Y Side-force coefficient measured in the store body axis system, side force/$q_\infty S$, positive in the positive Y_B direction

$\bar{c}$ Aircraft model reference dimension, in., model scale

FWD   Forward longitudinal shift of store relative to standard carriage position on pylon (12 in. full scale)

IS   Instrumented store with balance

M-117   M-117GP bomb with MAU-103A/B tail fins

M-117R   M-117 retarded bomb

M_∞ Free-stream Mach number

MER   MER-ION multiple ejector rack

MK-82   MK-82LDGP bomb

p_∞ Free-stream static pressure, psfa

q_∞ Free-stream dynamic pressure, $0.7\, p_\infty M_\infty^2$, psf

S ·   Store reference area, ft², model scale

TMER   MER mounted tangent to fuselage (without pylon)

WE   AGM-62/A Walleye guided bomb

X_{cg} Model cg location from nose of model, in.

a Aircraft angle of attack, angle between the aircraft waterline and the free-stream velocity vector, deg

ψ Aircraft yaw angle, positive nose to the right, deg

FLIGHT AXIS SYSTEM COORDINATES

Directions

X_F Parallel to the free-stream wind vector, positive direction is forward as seen by the pilot

Y_F Perpendicular to the X_F and Z_F directions, positive direction is to the right as seen by the pilot

Z_F In the aircraft plane of symmetry, perpendicular to the free-stream wind vector, positive direction is downward

Note: The flight axis system origin is coincident with the aircraft cg and remains fixed with respect to the parent aircraft during store separation. The X_F, Y_F, and Z_F coordinate axes do not rotate with respect to the initial flight direction and attitude.

STORE BODY AXIS SYSTEM COORDINATES

Directions

X_B Parallel to the store longitudinal axis, positive direction is upstream in the carriage position

Y_B Perpendicular to the store longitudinal axis, and parallel to the flight axis system X_F-Y_F plane, positive direction is to the right looking upstream when the store is at zero yaw and roll angles